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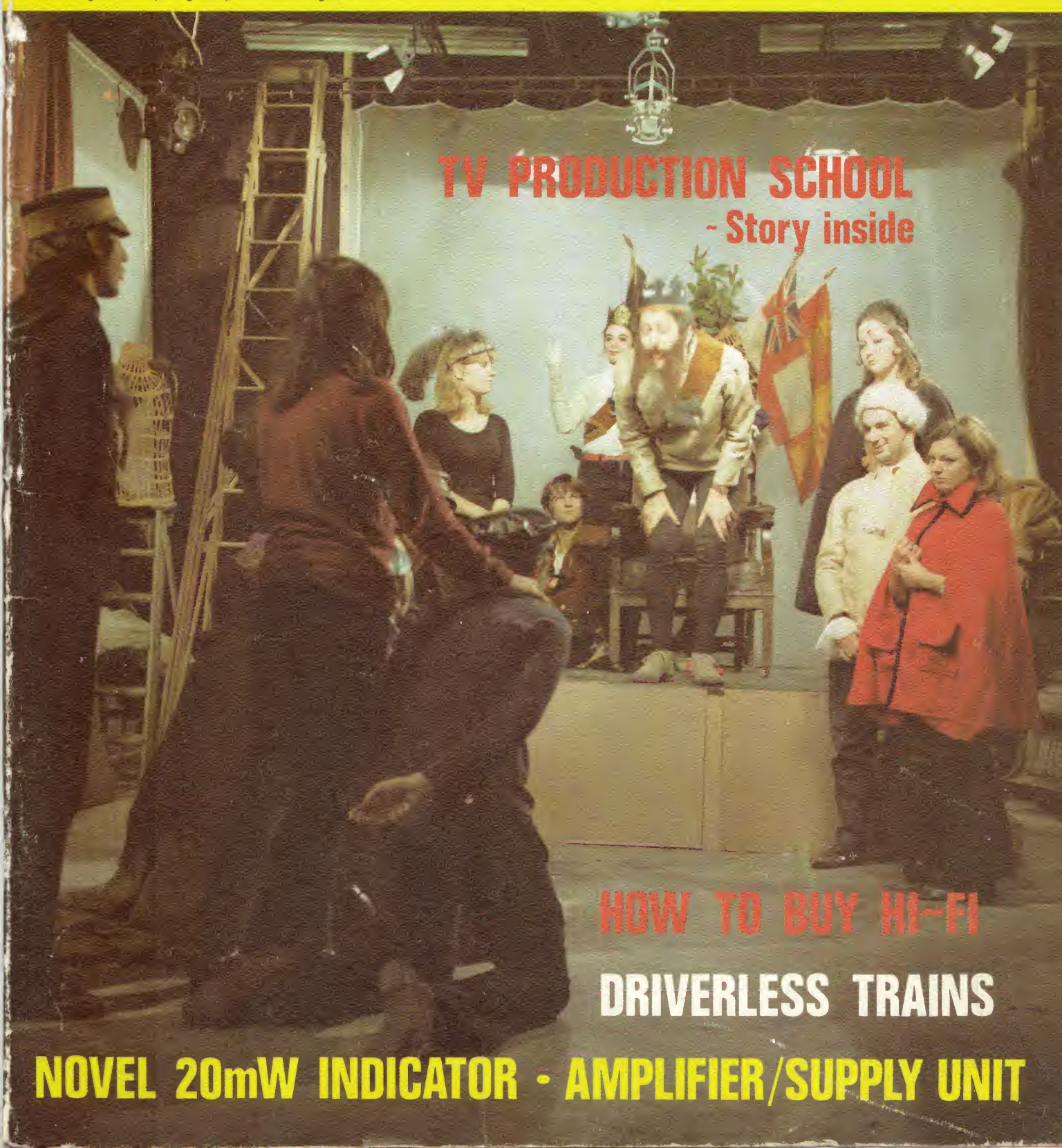

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~Story inside

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ELECTRONICS Australia

Incorporating "RADIO, TELEVISION and HOBBIES" and "MODERN WORLD"

AUSTRALIA'S LARGEST-SELLING ELECTRONICS & HI-FI MAGAZINE

VOLUME 33, NO 12

VICTORIA LINE: London's new underground railway linking the north-eastern suburbs with Victoria main-line terminus makes full use of a wide range of electronic devices, including driverless trains. (Page 14.)

MIC PREAMP: Do you need a small microphone preamplifier? A compact two-transistor unit is described on page 37. It uses a printed board only 2½ x 2⅛ in.

LOW-DRAIN LIGHT: Have you ever built a battery-operated solid-state circuit and found that the pilot light took more current than the rest of the circuit? Your troubles are over. An indicator, using a LED, with a drain of only 2mA appears on page 54.

On the cover

Our cover shows a unique training experiment in which television studio technicians and production people are trained together. The experiment has evolved into a full-fledged course at Ravensbourne College of Art and Design in the UK. See page 10.

CONTENTS — MARCH, 1972

world of electronics and hi-fi

projects and technical

regular features

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EDITORIAL VIEWPOINT

Colour TV: Target date at last

This is a hurriedly written replacement leader, necessitated because of the Prime Minister's announcement of 1st March, 1975 as the starting date for colour TV transmissions in Australia. As it happened my original leader for this month was concerned with this very subject, and presented the case for setting the starting date as soon as possible. Happily although the announcement has made the leader quite obsolete, it was made just early enough for me to write this replacement.

The announcement of the starting date is surely a welcome one, even though I am still inclined to believe that the original 18-month warning period would have been adequate. It would appear that most stations are only contemplating the transmission of film and videotape colour material in the initial period following the starting date, and I find it hard to believe that conversion of videotape and telecine equipment to colour would take more than 18 months.

The economic arguments I find even less convincing. In view of the obvious lack of agreement among economists concerning current economic parameters and their interaction, it is difficult to believe that any sort of valid comparison could be made regarding situations distant 18 months and 3 years into the future. Perhaps it is simply a matter of setting the date sufficiently distant in the future to justify an explanation of "sorry, no one could have foreseen . . ." if troubles occur.

Still, I must admit that probably the main reason for the slight disappointment over the 1975 starting date is the largely emotional one of national pride. How humiliating that our readers in New Zealand will be enjoying the pleasures of colour TV while we Australians will be watching "steam-age" black and white!

Of course these qualifications are largely irrelevant now that the date has been set. It is certainly true that March 1975 is a much more promising prospect than the indefinite future, and it also seems likely that even with the date set 3 years off the announcement will provide a much-needed boost to the present state of the Australian electronics industry. Now both receiver and broadcasting equipment makers can begin development and production planning in earnest, spurred not only by our own market but by the more immediate prospects of export to New Zealand.

Stations, programme producers and advertising agencies can now make definite plans for the training of production and technical staff in colour techniques. And the servicing industry has the opportunity to plan and organise training courses to equip service technicians with the additional skills they are going to need in order to adjust and repair colour sets. There will surely be no excuse possible if the commencement of colour transmissions finds the servicing industry unprepared.

We at "Electronics Australia" welcome the announcement, then, and look forward to March 1975 with enthusiasm. We certainly plan to play our part in helping readers prepare for "C-Day".

— Jamieson Rowe

ON SALE THE FIRST MONDAY OF EACH MONTH

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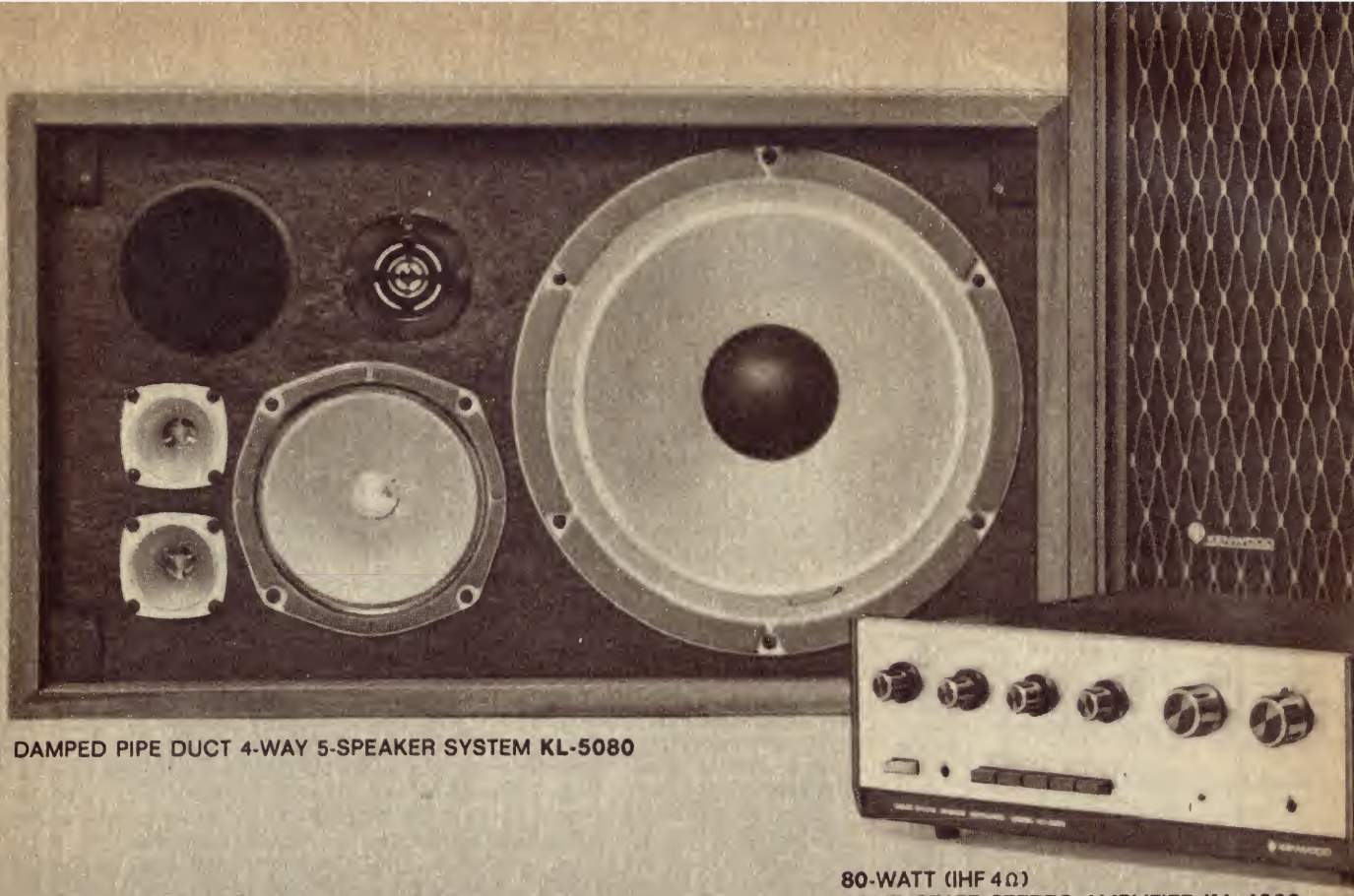

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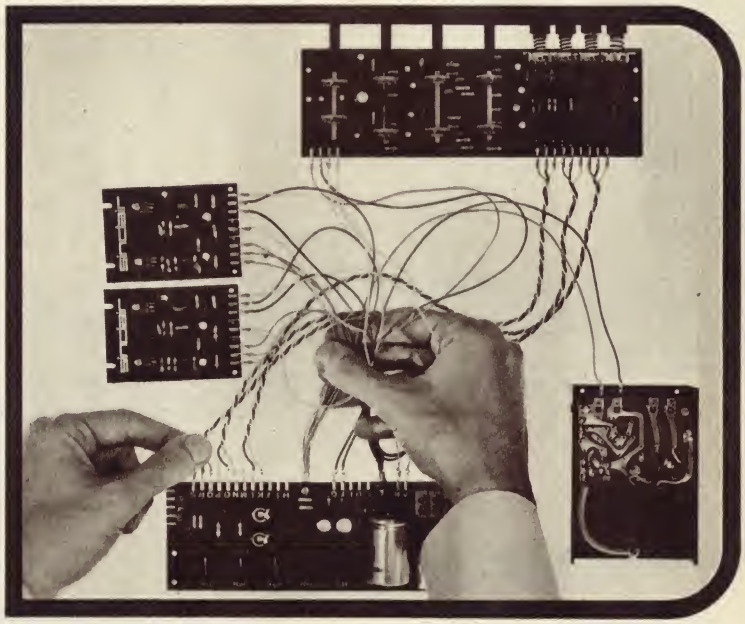

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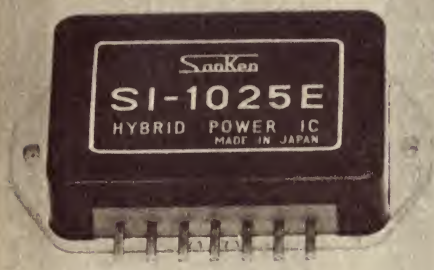

SERIES 1025E Characteristics;

Maximum rms power	25W
Output Load	8 ohms
Supply Voltage	48V
Absolute Max. Supply Voltage	55V
Supply Current	0.8A
Suggested Fuse	1A
Harmonic Distortion at Full Output	0.5% max.
Voltage Gain, Full Feedback	30 dB typ.
Input Impedance	70,000 ohms typ.
Output Impedance	0.2 ohms typ.
Output Coupling Capacitor	2200 uF 50 WV DC
Signal to Noise Ratio	90 dB typ.
Idling Current	30 mA typ.
Heat Sink (Minimum)	70 cm² (11 sq. in.)
Operating Temperature	−20°C to +80°C
Storage Temperature	−10°C to +70°C

SERIES 1050A Characteristics;

Maximum rms power	50W
Output Load	8 ohms
Supply Voltage	62V
Absolute Max. Supply Voltage	80V
Supply Current	1.1A
Suggested Fuse	2A
Harmonic Distortion at Full Output	0.5% max.
Voltage Gain, Full Feedback	30 dB typ.
Iuput Impedance	70,000 ohms typ.
Output Impedance	0.2 ohms typ.
Output Coupling Capacitor	2200 uF 75 WV DC
Signal to Noise Ratio	90 dB typ.
Idling Current	30 mA typ.
Heat Sink (Minimum)	135 cm² (21 sq. in.)
Operating Temperature	−20°C to +80°C
Storage Temperature	−30°C to +100°C

SERIES 1010Y Characteristics;

Supply Voltage	34V
Maximum Continuous Output Power (distortion<0.5%)	10W
Voltage Gain	30dB typ.
Frequency Range (output 1W)	20Hz~100kHz
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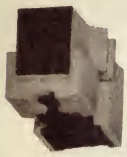

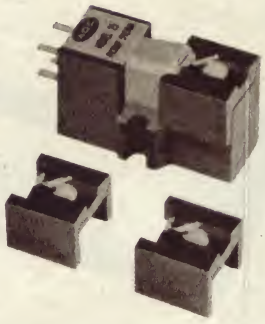

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ADC 550XE . . . $49.00 (post 25c)

ADC 550XE. Type: Induced Magnet; **Output:** 5 mV at 5.5 cms / sec. recorded velocity; **Tracking Force:** ¾ to 2 grams; **Frequency Response:** 10 Hz to 20 kHz ± 2 dB; **Channel Separation:** 20 dB from 50 Hz to 12 kHz; **Compliance:** 35 x 10^{-6} cms / dyne; **Elliptical Stylus Tip Radii:** Contact radius .0003". Lateral radius .0007"; **Vertical Tracking Angle:** 15°.

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Kit of Parts	$46.00 (1 cu ft), $58.00 (1.6 cuft)
Built and Tested	$60.00 (1 cu ft), $76.00 (1.6 cu ft)

SEPARATE COMPONENTS

Enclosure kit (1 cu ft)	$19.00 (maple), $19.50 (teak)
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Kit of Parts (teak or maple)	$26.00
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The Dovedale III kit employs a 12" bass, 5" mid-range and 1" tweeter. Cabinet 28" x 15½" x 10". 35 watts RMS

COMPLETE SYSTEM

Super Linton kit (Unit 3)	$49.00
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Dovedale III kit (Unit 5)	$133.00

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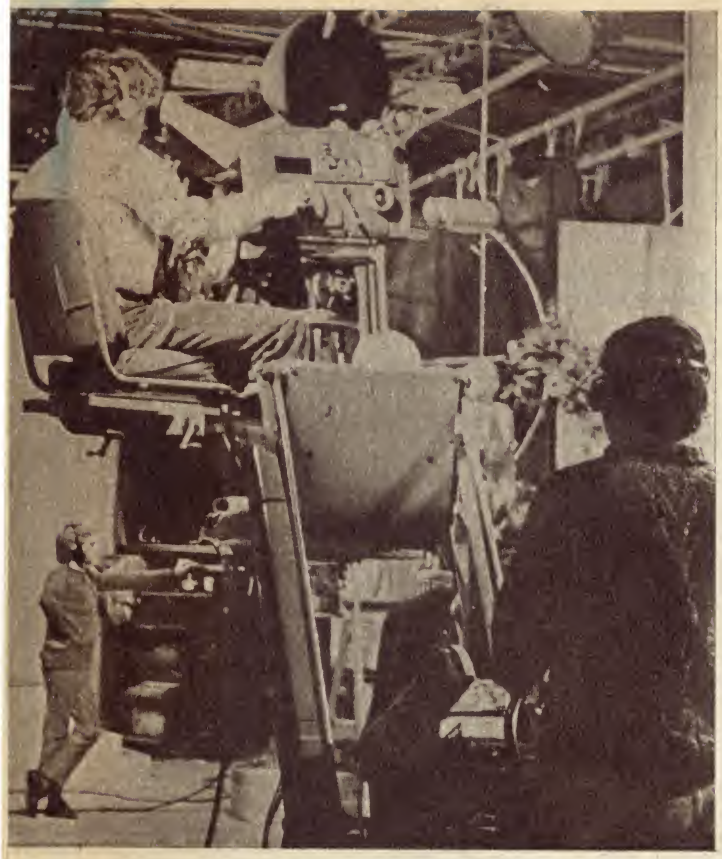


UNIQUE TELEVISION TRAINING SCHOOL

by COLIN MAITLAND

An experiment to train technical and production personnel for Britain's television industry, which started in a wooden shed in the grounds of a London school a few years ago, has proved so successful that the organisation concerned now has two fully equipped studios, and plans to expand its activities this year.

With a yearly staff turnover of less than 3%, the television companies of Great Britain (including the BBC) would scarcely seem in need of outside training facilities to supplement their own schemes. Yet training programs for production and technical staff vary from company to company throughout the United Kingdom. These companies seem to have no common standard by which to judge applicants for positions, and for the enthusiastic but inexperienced applicant, entry into the industry can be difficult to achieve. The situation is, then, that one of the world's advanced television nations lacks any form of recognised training policy.

Outside the industry itself, private training establishments with sufficient hardware and expertise to offer high-quality practical instruction are rare; so rare in fact that the discovery of a training school with a fully equipped studio complex in a quiet London suburb is unusual enough to merit a brief study of its aims and origins.

The school, which bears the impressive title "The Television Department of Ravensbourne College of Art and Design" has an interesting history.

In 1965 Robert Butler (now Head of the school) was with ABC TV — one of Britain's "Big Four" independent companies, now merged into Thames Television. He was sorting through piles of job applications, bemoaning the lack of interest in television by the nation's vocational institutions, when his complaint was overheard by John Cole, then principal of Beckenham Art School. A challenge was issued — leave the security of a career with ABC and embark on an unprecedented project: the establishment of a complete college department devoted to training television personnel. Butler took up the challenge.

Work had to commence from the ground up, there being no money, no staff and no accommodation! An initial capital of £114 was acquired, then the accommodation problem was solved when the neighbouring Beckenham and Bromley Art Schools merged into Ravensbourne College and the embryonic "Television Department" was given a wooden shed in the college grounds.

It was at this time, with premises of a sort having been obtained, that Butler thought it necessary to warn off any who might attempt to water down the standards he had set for his project.

"We laid down our principles for the course and said we'd do things to the highest possible standards or not at all."

At no time since has that declaration been withdrawn or modified.

The acquisition of equipment was now of paramount importance and though the kitty had now grown to £3500 it was difficult to foresee how even the barest minimum of hardware was to be obtained for such a sum. A miracle was needed — and it came. A deal was struck which was to set the pattern for the future of the entire project.

Granada Television of the "Big Four" were disposing of a fully-equipped outside broadcast vehicle and generously agreed to a lower-than market price. The deal emptied the kitty again but provided the basic equipment needed for training.

Robert Butler takes up the story:

"In getting the initial syllabus and curriculum together we decided to train our technicians and production people together. It is a mistake to have a technical school for technicians and an art school for production people.

"We were delighted to find the Department of Education and Science agreed with us, and we were given the ground floor of our present building plus £5000 to turn it into a TV studio!"

The pioneering days were over, but the hard work was just beginning. £5000 wasn't nearly enough to convert the old building, once an infants' school, into a functioning studio complex, so much of the conversion work had to be undertaken on a do-it-yourself basis. It was hard, sometimes backbreaking, work as staff and students shared in knocking down walls and wiring in circuits, but it was worth it — the Depart-

ment now had its own premises, room to expand and recognition as a going concern.

As seen today, the original project has undergone an astonishing metamorphosis since those embryo days in a wooden shed. The old school building in rural Bromley, now contains two working studios (the second came into operation this year) and £350,000 worth of equipment.

Studio A — the first year training studio — has a floor area of 1800 sq ft (though only 16ft 6in high) and is equipped with four Marconi image orthicon studio cameras, lighting control equipment and provision for 35mm back projection; Studio B also has 1800 sq ft but is 26ft high, thus allowing a more flexible lighting grid. It is equipped with two colour cameras and four Marconi black-and-white cameras channels. There are 23 Marconi cameras in all, some of them in various stages of disrepair.

One control room is used for both studios, productions being time-tabled to ensure both studios are not in use at the same time. The list of equipment available also includes Ampex video tape recorders equipped with inter-sync, allowing VTR inserts; an EMI twin-lens tele-cine machine; flying-spot-scanner for monochrome and Cintel scanner for colour. Sound control is by a Pye 16-way mixer, Thorens turntables and Brenell tape decks. Track preparation is carried out on Ampex and Revox tape recorders.

Film inserts and occasional film projects are catered for by a 16mm blimped Arriflex camera recording onto a Perfectone recorder, 16 / 35 mm Camiflex, Westrex and Acmeola editing equipment, Ross 35mm projector and Siemens 16mm projector.

At present the studio is operating only with monochrome equipment, but plans are in hand to change over to colour operation. This may be within the next 12 months.

Even that incomplete survey of technical facilities underlines the intentions of the Department's originators to offer as complete a course as possible to aspiring television personnel. Robert Butler points out however that such a formidable array of hardware could never have been amassed without a great deal of generosity and goodwill on the part of the television industry itself. The successful negotiations with Granada for the OB vehicle set a pattern of co-operation between Department and industry obviously prompted by a belief in the project and the validity of its aims.

A random list of equipment (all obtained free or at a nominal price) is indicative of the interest shown in the Department and its work:

Marconi Mk 3 camera channels, pulse generators etc from London Weekend Television (now Thames); zoom lenses from Independent Television News; film equipment from ABPC, Hammer Films and MGM; two colour cameras from Intertel; virtually all lighting, distribution, amplifiers, pattern generators from Granada Television; Marconi BD 689 synchronising generators and both Ampex video tape recorders from Thames Television; assorted equipment from Rank Cintel, Pye and Ampex (who gave a 400 tape head free); plus much more.

"Only those able to submerge their ego and work for the team will succeed in television."

While this array of hardware is impressive, it would be of little use if it were not used so as to train personnel to cope with the precise requirements of television as a medium. However, the eight members of the teaching staff are all former television professionals, and experienced and articulate instructors. Students do not merely take a passive role in the operation of the equipment. Instead of being relegated to the position of spectators, they take over fully the operation of the studio during production of programs.

The actual intake of students is inevitably small, there being only 15 production places and room for an equal number of technical operative students. These limits are governed as much by the industry's ability to provide employment as by the limitation of teaching facilities. Entry qualifications are not dauntingly stringent — for the Tech Ops Course entry is at 17 plus with a minimum of Science and Mathematics at General Certificate of Education "O" (ordinary) Level, while requirement for the Production Course is a minimum of five "O" Levels including three "academic" subjects. (The General Certificate of Education is Britain's most widely accepted educational standard. Two or three ordinary-level passes are necessary for most non-manual jobs).

Two-year, full-time courses are offered and students find during their first year that a strong emphasis is placed on working together.

Robert Butler says: "At school these kids were trained to be individualists, so in their first year here considerable time is spent in getting them to work together as a team. Only those able to submerge their ego and work for the team will succeed in television."

The two courses are complementary and interdependent, with continual emphasis on the dovetailing of aesthetic and engineering problems. For Tech Op students, areas of specialized interest such as mathematics, radio and line transmission, technical direction, etc. are covered; Production students will be taking a wider look at the complexity of television production as well as deciding on the position they eventually wish to occupy.

Additional factors during the course are lengthy student production meetings during which a wide range of viewpoints can be exchanged and guest lecturers called in to discuss the latest developments and techniques. Guests range from designers to cameramen and are valuable means of stimulating discussion of television in its wider terms.

technicians and production people work together and help train one another . . .

In a twelve-week term, six productions are normally scheduled, ranging from pop shows and dramas to educational dramas.

Plays are generally cast with professionals. Ultimately, at the end of their second year, Production students will be allocated a crew chosen by the tutorial staff, and will produce a kind of "telethon" running up to six hours with each student responsible for a segment. Outside assessors drawn from the industry will view the finished program and read all technical reports before passing judgment on the students' capabilities.

Britain's television industry has already indicated its regard for Ravensbourne training in the most practical way: of all the Department's students since its inception, only four are not now employed in the television or film industries — and they opted out by choice.

1972 will almost certainly be a year of change and expansion for the Department. Plans are well in hand to provide colour television facilities in the Department's studios; also, with a second Indpendent TV channel nearing reality, more student places may be urgently needed, and expansion of training facilities may be necessary.

One new teaching experiment is certain to take place, necessitating greater self-reliance by the students in return for greater autonomy.

The scheme will require second-year Production students to have as their crew first-year Tech Ops, while second-year Tech Ops will work with, and train, first year Production students.

Finally there have been discussions with certain Independent Television companies with a view to a more formal association with the Department and a closer working relationship.

Only time will show whether such plans will come to fruition. It is certain however that the under-staffed and under-financed experiment which started in a wooden shed has been a major success, both in scholastic and technical terms.

New tweeter—180° radiation pattern

Add-on tweeter system is designed to improve high frequency performance of existing high quality speaker systems.

Those of you who remember our do-it-yourself tweeter project (pictured at lower right) should have a keen interest in the "Microstatic", a new add-on tweeter system which will soon be available in Australia.

Our tweeter project, using a single Wharfedale PST-4, was not as elegant a design as the Microstatic, but was designed with the same purpose in mind. That is, to improve the performance of existing loudspeaker systems by adding a separate tweeter enclosure designed for wide angle dispersion of higher frequencies.

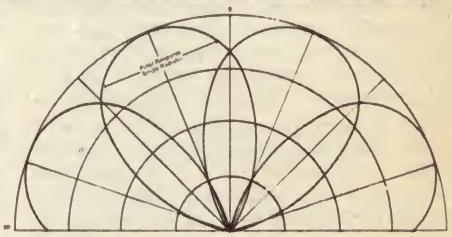
The Microstatic, with each of four driver cones facing at a different angle, provides virtually 180° dispersion at frequencies from 3.5KHz to 20KHz (±2dB to 18KHz), something that few loudspeaker systems can match. In fact it is the relatively expensive loudspeaker system that the Microstatic was designed to complement.

The new system is claimed to give outstanding performance in stereo use because the wide dispersion helps the listener locate individual sounds in the correct perspective.

Micro / Acoustics Corp., of Elmsford, New York, USA, who manufacture the Microstatic tweeter, was founded by Arnold Swartz, an electronics engineer who is well known for his audio product designs. He designed the Micro-Point Recording Stylus, widely used in the manufacture of stereo LP records, and the CBS Laboratories Test Record Series, the major standard for testing and evaluating phono cartridges (in fact, we use these records in the E-A laboratory for testing cartridges).

After three years of research, Mr Swartz and his associates have produced dynamic radiator cones of extremely low mass and small area which they claim provide the advantages of electrostatic tweeters without the drawbacks.

More details on the Microstatic will no doubt be published in the near future, but meanwhile you can get more information by posting one of our Reader Information Service coupons on the back page.



Polar response chart of the Microstatic tweeters shows how they overlap for uniform output across 180°.

W. C. Wedderspoon Pty Ltd, 193 Clarence St, Sydney, 2000, have been named Australian distributors for Micro / Acoustics products.

The E-A 1963 Add-On Tweeter used a single loudspeaker in a wide-dispersion enclosure.

Automatic train control on London's Victoria Line

RAILWAY WHERE TRAINS

When London Transport brought its Victoria Line into service three years ago, London became the first city in the world to have automatically controlled driverless trains in a public transport network. The automatic train system, and other automated features introduced at the same time, have proved so successful that the British Government has now approved construction of a second automatic line, the Fleet Line, and London Transport is planning the conversion of its existing lines to automatic operation. Some of the automatic features used in the operation of the Victoria Line are discussed in this article.

In 1962, after years of discussion, planning and preparation, the UK Government authorised London Transport to proceed with the construction of a new underground railway linking the north-eastern suburbs with the main line terminus at Victoria. The initial proposals for this Victoria Line went back to before the 1939-45 war, and detailed planning had already been completed. In fact, a pilot tunnel over a one-mile section of the route had already been built, with the object of deciding what tunnelling and lining techniques would be the most suitable.

Later planning had provided for a full-scale use of electronic devices, leading to such innovations as driverless trains, communications facilities between control rooms and trains, computer-controlled train routing, automatic fare collection and ticket dispensing, ticket barriers operated by magnetic coding on tickets, and a complex system of closed-circuit television.

It is not the purpose of this article to dwell on the massive engineering work involved in the construction of the underground tunnels and the permanent way, nor the major alterations to existing stations which coincided with the design and construction of some new stations. This has been outlined in the book "The Story of the Victoria Line", by John R., Day, published by London Transport. Rather, it will deal with the extensive electronic systems used, mainly those concerned with the operation of driverless trains, signalling, automatic fare collection and ticket dispensing, automatic turnstiles, and closed circuit television. The following descriptions of these aspects of the system have been based on Mr. Day's book.

Within weeks of the government authorisation for the railway, London Transport installed an experimental closed circuit television system at Holborn station, one of the busiest stations in the London underground system, handling some 32 million passengers a year.

Cameras were set up on all four platforms, in the ticket hall, and at the foot of the lower flight of escalators leading to the Piccadilly Line. An operator, sitting at a control console in a special "crow's nest" compartment built on the wall of the concourse at the foot of the main escalators, can switch the pictures from any of the cameras on to three monitor screens in front of him. Three of the cameras have remote control of pan and tilt, so that the operator can turn them to pick up anything which attracts his attention or to accord with morning or evening passenger flow. The "crow's nest" has one-way glass, so that the operator also has a direct view of the main escalators — the only four-escalator bank at any London Transport station.

If the pictures show that pressure is building up at any point the operator can warn the station staff by telephone or he can switch on a microphone and address passengers direct through the station public address equipment.

Another innovation tried out at Holborn in readiness for the Victoria Line was a passenger information service which allows a passenger, from a "head booth" similar to those now extensively used for telephones, to ask the television operator for information about the train service, etc. The operator answers by means of a "talk-back" loudspeaker in the booth. (This service was later extended to the next station, Russell Square, in the heart of a

A driverless train pulling into a typical Victoria Line station (Seven Sisters). The trains have bright aluminium coachwork and are equipped with talkback facilities enabling the train controller to talk with the central control room and vice versa.

All pictures used with this article are reproduced by courtesy of London Transport.

HAVE NO DRIVERS

tourist hotel area.)

The first contracts for the engineering work were placed in late 1962. The first section of the line began operating six years later, in December 1968, and the line was officially opened by the Queen in March, 1969, following the completion of the third (and at that time the last) section. Since then, the decision has been made to extend the line to the south side of the Thames, to Brixton.

The Victoria Line has silver trains of unpainted aluminium alloy. Each train has only one crew member, called the train operator, whose main job is to close the doors and start the train once all passengers are aboard. Once the doors are closed, and twin "start" buttons are pressed (two to avoid accidental starting by inintentional pressing of one) the trains operate entirely automatically, responding to coded signals transmitted through the track.

Coded impulses from the track cause the train to accelerate, coast, brake to a halt at the next station, slow down or stop and restart as required if there is another train ahead or if there is a speed restriction on part of the route. The train operator, stationed in the front cab, can take over and drive manually in the event of any failure of the automatic equipment.

The automatic driving equipment can be divided into two basic parts, the first of which corresponds to the signalling system of a normally operated line and is concerned with the safety of the train; and a second part (which the first can over-ride if necessary) which is concerned with the actions normally performed by a driver or motorman operating his controls.

A train cannot run unless it is receiving a continuous series of coded impulses transmitted through the running rails. If no code is received the train cannot start; or, if it is running when the impulses cease, the brakes will be applied and the train will stop. There are several different codes which set the ranges of speeds within which the train can run; thus a frequency of 420 pulses a minute allows the train to run without any restriction of speed; a frequency of 270 pulses a minute allows the train to run under power at up to 25mph; and when it is receiving 180 pulses a minute the train can run at up to 25mph. provided that power is not being fed to the motors. The codes are received inductively by coils mounted on the front bogie of the first car of the train. A fourth code of 120 pulses a minute is also used but this is in connection with the operation of signalling equipment only and is not picked up by the train.

The three slower codes are generated by timed pendulums and associated electronic equipment. The 420 code is generated entirely electronically. The lines are divided into sections for track circuiting purposes in the same way as for normal signalling, but the state of the track circuits ahead, showing whether the line is occupied, automatically determines the code to be fed to the track in any section.

ABOVE: The central control room of the Victoria Line, with its illuminated system diagram and closed circuit TV monitors.

BELOW: One of the automatic unattended exit gates, equipped with ticket inspection facilities.

(A track circuit — the basis of all modern signalling — is an electrical circuit running through one rail and back along the other in a section of track isolated from those at each end of it. A train on the line interrupts the circuit and thus shows its presence.)

A tachometer generator mounted on the end of one of the traction motors is used to feed an electronic governor which controls the train speed at 22mph on the 270 code. This governor will hold the train speed to within ±2mph of the nominal 22mph. Since neither the electronic governor nor the braking system it controls is fail-safe, a mechanical governor of proved reliability is also used, driven by gearing from an axle of a trailer (non-motorised car). This will open a trip valve of the pneumatic braking system if the indicated speed is exceeded by a predetermined margin.

So far, except for the electronic governor, we have dealt with the safety signalling system, which, as we have said, over-rides commands related to the driving of the train. These driving commands are given to the train by "command spots", which are short sections of running rail about 10ft long through which audio frequency currents are passed. No special insulation of these sections is necessary.

In a typical run between stations the train has to start under power and run under power to a point where it will be able to coast to the next station. As the train nears

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AD27

the station, the brakes have to be applied to bring the cars to a halt in the right place at the platform.

When the train operator closes the doors of a Victoria Line train and presses the twin "start" buttons, the train will be receiving the 420 code — provided the track ahead is clear — and will move off under power. (The code being received is displayed in the cab for the information of the operator.)

The train continues to run under power until it reaches the point at which calculations and tests have shown that power should be cut off, and at this point there is a command spot with a 15KHz current passing through it. This is recognized by the train-mounted equipment, power is cut off and the train begins to coast. As it approaches the next station it meets the first of a series of command spots with speed-related frequencies, a frequency of 100Hz corresponding to 1mph. Thus the first spot might dictate a speed of 35mph and have a frequency of 3.5KHz. Other spots follow, each bringing the speed down by, say, 5 mph.

The speed reduction needed is calculated automatically by a comparison of the actual speed of the train, in terms of frequencies produced by a train-mounted tachometer generator, with the frequencies received from the track. The brakes are then applied or eased as required until the speed drops to 4mph. The braking is then "eased out" to give a smooth stop at the platform. The braking is controlled down to this speed by mercury retarder switches which are able to select any one of three rates of braking as dictated by the closeness of the actual to the required speed. A constant-pressure control is used to apply the brakes at speeds below 4mph, and this also holds the train while it is standing at a platform.

The signalling system of the Victoria Line has been specially designed for the automatic driving system, and has significant differences to that used on other London Transport lines. One of the main differences is that there are fewer fixed coloured lights alongside the track. Another is that there are no train stops, which are used on other lines to apply the brakes automatically to any train which over-runs a red signal; this change is more apparent than real, since a signal at danger means no code passing through the rails, the absence of such a code causes an immediate application of the brakes. In practice, it is quite unlikely that a train would pass a danger signal, as it would previously have passed a "command spot" which causes a normal brake application before the train reached a signal at danger. In these circumstances, the train would be stopped before it reached the unfavourable signal, without an emergency brake application.

If, when the train passes a predetermined point between the command spot and the signal, it is still travelling too fast to stop at the signal, an emergency brake application is made. Everything in the equipment is designed on the "fail-safe" principle, i.e. any failure of apparatus will always be on the side of train safety.

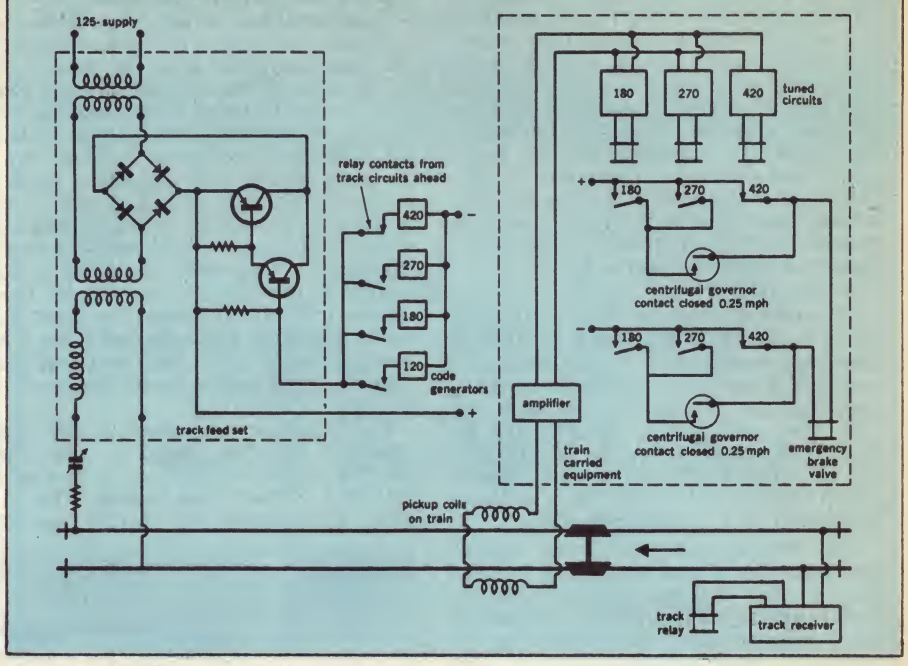
Where there are no junctions on the line, signals at the track side are not really necessary, but some (starting, intermediate, and outer-home) are provided for the benefit of the train operator in case he has to drive manually at any time. A system of "moving overlaps", made possible by the coded pulses in the rails, ensures that one train can approach, in complete safety, to within a short distance of another when the first train is accelerating away from a station and the second is slowing down to stop at it. On the assumption used in London Transport signalling calculation that a station stop lasts 30 seconds, one train could follow another on the Victoria Line at a time-interval of only 82 seconds.

The control room for the Victoria Line is a circular room with its walls covered with illuminated diagrams of various types. The Victoria Line signal regulator diagram extends for about a quarter of the way round the room and facing it is a desk for a Train Regulator. Behind him, at an angle, is another desk for the Victoria Line Traffic Controller. Generally speaking, the Regulator's job is to watch that the trains are working in accordance with the time-table punched on the program machines, and to observe the movement of the trains. He is assisted by the lights on his diagram, which reveal the whereabouts of every train on the line and the state of all signals. The controller has the task of seeing that the train service adheres as closely as possible to the timetable.

To the left of the Traffic Controller is another panel — the traction diagram panel — which displays the layout of the current supply system, with substations, switches, etc., and shows which sections of the system are switched on or off. There are also switches which allow the Traffic Controller to disconnect the conductor rails in the tunnels from the traction current supply, or to turn the current on. Splitting the line into nine sections for current supply purposes makes it possible to detect a train with some types of electrical fault as it passes from section to section. From the panel, the Controller can also speak by plug-in telephone to any Train Operator who makes use of emergency means provided in the tunnel to turn off the traction current.

A green light shows when a program machine is working normally. A yellow light shines when the machine has been switched to deal with each train as it comes along ("first come — first served" working), and a red light when the points and signals at the location concerned are being worked by the Regulator by remote control from the control room — all points

The safety signalling equipment — how it works



The following brief explanation of the safety signalling system is based on a paper published in "Proceedings of the Institution of Mechanical Engineers", Vol 179 Pt 3A, by R. Dell and A. W. Manser (London Transport Executive).

The general arrangement of the system is shown in the schematic diagram. The system is current operated, and coils mounted at the front of the train sense the presence of the coded currents flowing through the rails, since the coils are in effect inductively coupled to the rails.

As explained in the main article, the various frequencies of the coded signals correspond to speed limitations for the trains. These signal currents are applied to one rail, and will flow through the axles of any train on the section of line, the signal path being completed by the other rail.

Since the train axles complete the signal path for the coded signals, no signals will proceed along the line past the train. As explained in the article, absence of signal on the line corresponds to "danger", and any train entering a section before the preceding train has cleared the section will have its brakes applied automatically.

The code generating equipment is controlled by relays from the track sections ahead. As the track circuits applying to the sections ahead become clear, the codes are successively raised to 180, 270 or 470 pulses per minute.

and signals can be worked in this way in emergency. A flashing green light shows that a machine is working to its set program without reference to the train description.

A program machine control panel is built into the Regulator's desk, and this can be connected, by pressing code buttons for the site and a particular machine, with any program machine. When the connections are made, the Controller can set up the points and signal an extra train, or cut a train out of the program, or make any other adjustments to the working of the machine concerned. The program machines give audible or light warnings of any departures from the set working.

In railway routing and signalling systems, the usual practice is to have an "interlocking machine". This is designed to ensure that points and signals cannot set up anything other than safe routes for trains.

In the conventional signal box, the signalman pushes buttons or pulls levers to tell the interlocking machine what routes to set up. On the Victoria Line, this function is performed by a "program machine".

This program machine carries the full particulars for a week's timetable in coded form on a roll of punched plastic tape. The code instructs the interlocking machine on the setting of points and signals for the passage of each train according to the timetable. As one train passes, the tape steps on to the information relating to the next train. In this way, it works right through the daily timetable and then runs back automatically for the start of the next day's timetable. On Friday evenings, instead of rolling back, it proceeds on to a special section for weekend timetables.

Recognising that even the best run railways do not always manage to adhere strictly to the published timetables, the designers of the program machine have given it a limited capacity for storing particulars so that trains can be dealt with out of sequence. Each train identifies itself by a coded signal, as is explained later. If the timetable and train description (identification) do not agree, the machine will sound a warning to the Regulator in a remote control room. If he decides no special action needs to be taken, the machine will automatically route the train in accordance with its description.

On other Underground lines the description of a train is fed into the signalling system by the signalman or program machine at the terminus from which the train starts. The description precedes the train automatically from signalbox to signalbox (or the equivalent) down the line until the train reaches its destination. As well as identifying the train to the staff the description is used to operate the train destination signs provided on the platforms for the information of passengers.

On the Victoria Line the method is different, the trains identifying themselves by the Identra system. The train equipment consists of s single coil which reacts with two coils mounted in fixed positions on the track. The coil on the train is capable of being tuned so as to vary the frequency which is produced by the two fixed coils as the train passes them. This variation in turn is recognized as signifying one of the possible destinations. The information can then be used in announcing the train at stations and by the program machines in checking the approaching train against the one predicted by the timetable.

Consideration is being given to another method of identifying trains and keeping a full record of their progress. This is the "train recorder and number writer". Each train on the Victorial Line would have its number marked in ordinary numerals on the side, and this would be read by a scanning system and recorded — again in ordinary numerals — on a chart. The moving chart would be marked with a code of dots giving a time reference and marks showing how long each train spent in each station on the line. The pens would be so spaced that all the marks for one train would appear in a straight line if the train was running to time. Any variation from normal performance could therefore be seen immediately.

The Regulator can speak to any Train Operator (or vice versa) at any time, whether the train concerned is moving or not, by a carrier wave system. This is a great improvement on former methods when the controller could not get in touch with a train unless the driver had stopped his train and connected equipment on the train to the telephone wires provided at the side of all tunnels. The tunnel telephone system is still available as a standby and still serves to cut off current in an emergency by the simple process of touching the two bare wires together or connecting a handset to the wires.

Five years' experience in the use of prototype television equipment at Holborn station amply confirmed its usefulness in helping to control the movement of crowds and to deal with emergency situations, and full advantage of the possibilities of this new aid — also tested by underground systems abroad — has been taken.

At most stations on the new line an operations room, generally at ticket hall level, has been equipped with two 11-in monitor screens on which the supervisor in charge can select pictures from any of the cameras at his disposal. A microphone connected to loudspeakers on the platforms enables him to make announcements to passengers as necessary.

Cameras are recessed into the walls at both ends of every station platform and are also sited at strategic points elsewhere in the stations, e.g. at the foot of escalators and in busy interchange concourses. This same system gives the controller also a visual link with all Victoria Line stations. He has two 19-in monitors on which he can see images from a camera on each station platform, so that in the event of a delay to the service he can see the effect of the trouble at a glance. A two-way sound system, linked to the television equipment, enables him to hear as well as see what is going on within the range of each camera and to speak to passengers through the platform public address system if required.

Monitor screens for the Train Operators are sited on each platform near the point where the front of the train stops. These screens show the picture transmitted by the camera mounted at the opposite end of the same platform so that the operator can see what is happening at the rear half of the platform in crowded conditions to help him in closing the doors.

Inwards and outwards gates of a Victoria Line station (Seven Sisters) where automatic fare collection is in operation.

Some of the escalators are fitted with photo-electric controls to reduce the speed of ascending escalators by half when they are not carrying passengers, thus reducing wear and current consumption. The speed of travel is accelerated very smoothly to full speed when a light ray directed to a light sensitive cell is broken by a passenger boarding the escalator. The escalator slows again when the passenger reaches the top and passes through another light beam, provided that no other person has boarded it in the meantime.

Automatic fare collection, ticket dispensing and barrier control were planned for the Victoria Line from an early date, along with a plan to extend such systems to the whole of the London Transport underground system.

Several different systems have been tried on an experimental basis at different stations. As a result of these trials, the most suitable systems have been determined. These will be used at all Victoria Line stations, and plans are being drawn up to use them eventually throughout the whole London Transport railway network.

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NEWS HIGHLIGHTS

Optical levitation achieved

glass sphere is made to float on beam of light

Scientists at the Bell Laboratories in Holmdel, New Jersey, have succeeded in supporting small spheres of transparent glass by a beam of light from a laser. The tiny glass spheres are approximately 20 microns in diameter, about one-third the diameter of a human hair.

In the experiment, conducted by Bell Labs scientists Arthur Ashkin and Joseph Dziedzic, a sphere is raised from a glass surface and supported in an "optical bottle" formed by focusing of the laser beam. Radiation pressure from the light photons not only counteracts gravity, but also prevents the sphere from slipping sideways out of the beam.

The new technique is expected to provide a simple, precise method of manipulating small particles without mechanical support. It could be of use in communications research to measure scattering loss due to particles in the atmosphere or in other media.

Implantable device to re-start hearts

An implantable electronic device, called a transvenous automatic defibrillator, is about to be tested on humans. It can detect and automatically correct the derangements in heart rhythm that cause most deaths from heart attacks. The device was described at a recent medical conference in the USA by Dr Michael Mirowski of Johns Hopkins University, Baltimore. It is a battery-operated device similar in concept to a heart pacemaker implanted to keep the heart beating at the proper rate.

The defibrillator, about the size of a small transistor radio, has a long piece of plastic tubing attached. The end of the tubing, which contains a sensing element and two electrodes, is inserted through a vein into the heart itself. Should the main heart muscle begin to fibrillate — i.e., function abnormally in a way that prevents it from pumping blood round the body — the sensors detect this and the electrodes automatically deliver a shock to the heart to restore it to normal rhythm.

New cables under Pacific

Subject to the approval of the governments concerned, a two-stage $500-million plan to expand cable capacity in the Pacific area will begin later this year. The plan, aimed at maintaining a reasonable balance between cable and satellite communications capacity, was tentatively drawn up at a recent meeting of Pacific telecommunications operators held in Sydney. The meeting was called by the general manager of OTC Australia.

The first stage calls for the laying of a new cable with 845 voice channels, between the US west coast and Honolulu, between Honolulu and Guam, and from Guam to Japan. The Seacom cable linking Australia with Guam would be upgraded by the installation of a device known as TASI-B (Time Assignment Speech Interpolation). The capacity of 100 circuits of the total number in the cable will be nearly doubled using TASI-B, raising the total capacity of the entire cable to about 250 circuits.

The second stage still involves further analysis and detail work, but it provides for a high capacity (perhaps 1840 channels) cable between Australia and Hawaii, a 1600-channel cable from Japan to Hawaii, and an additional 3500 to 4000-channel cable from Hawaii to the US mainland. The second stage would be completed towards the end of this decade.

Australian satellite experiments confirmed

Scientists from several Commonwealth departments will be co-operating with NASA in evaluating imagery taken over Australia by the Earth Resources Technology Satellite (ERTS-A), due to be launched in May, 1972.

Their proposals, made in 1970 through a Commonwealth interdepartmental committee, have been accepted by NASA. NASA will supply by way of the committee, imagery of certain preselected test sites in this country that are well known from previous ground and air surveys. Participating scientists will then determine the usefulness of the imagery in their field of work and report their findings to NASA.

"Imagery" is a term used by NASA to describe pictures taken by electronic scanners and video cameras and reproduced photographically.

The ERTS-A satellite and its electronics package were described in detail in the October 1971 edition of "Electronics Australia".

Although the full value and technical quality of earth resources imagery from satellites have yet to be determined, it is hoped that this new information source will provide significant data about

Australia in the fields of agriculture, forestry, hydrology, geology, oceanography; cartography, population and urban planning and pollution.

After launch, the satellite will pass over Australia in a southerly direction (about 12 degrees west of south) at about 9 am local time. Electronic data obtained during the passes over Australia are to be recorded on board the satellite for later relay to receiving stations in the US, where the results will be printed photographically and returned to Australian participants.

The primary sites proposed to NASA are in six orbit corridors, each 100 nautical miles wide, as follows:

1. Maryborough, Hunter Valley, Canberra, Gippsland, South Tasmania;
2. Fitzroy region (Qld), Griffith, Melbourne;
3. Eastern Papua, Cairns, Broken Hill, Mildura, Coonalpyn, Penola;
4. Western Papua / New Guinea, Burketown, Mt Isa-Cloncurry, Gason, Flinders Ranges:
5. Gove, Tennant Creek, Alice Springs;
6. Fitzroy region (WA), Kalgoorlie.

Other test sites have been proposed by State authorities and Universities, and it is possible that NASA will also approve these.

Private companies wishing to take part in the evaluation of imagery from the satellite may obtain further information from the Director, Bureau of Mineral Resources, PO Box 378, Canberra City, ACT, 2601.

PICTURES IN TWILIGHT. Texas Instruments' new Tivicon solid state image pickup tube shows what it can do at low light levels. Photo at left was taken in daylight; photo at right was taken under identical conditions except at reduced light level. The tube was mounted in an Ikegami CTC-500 camera during an evaluation done by Australian Video Engineering. Inside the tube is a target wafer containing 2.4 million photo-diodes.

STC man develops press safety device

A safety interlock device for power presses developed by an engineer at Standard Telephones and Cables has attracted widespread interest from both Government departments and private industry. The device, developed by STC plant engineer Eric Francis, has been fitted to a number of 30 and 60 ton presses in the company's Alexandria and Liverpool works since early 1969, and has been shown to be entirely effective. It consists of a slotted steel disc mounted securely on the main crankshaft of the press, with a mechanism such that the crankshaft and ram are positively locked in the top position until the safety guard is fully lowered.

Dr Hopper to speak

Dr Grace Hopper, one of the world's leading authorities on computer programming languages, will address the 5th Australian Computer Conference in Brisbane. Dr Hopper has been designing programs since pre-computer days in the 1940s when she worked on the electro-mechanical automatic sequence-controlled calculator at Harvard University.

The conference will be held from May 22 to 26.

International prize to APO man

An entry by Mr Arnold Holderness of the Australian Post Office won first prize in the international lead power 71 competitions judged in Hamburg, West Germany. The award was made for the development of an unattended uninterruptible power supply for remote areas using lead batteries and wind-driven generators. The power supply is used in the 1427-mile long East-West microwave link between Northam, WA, and Port Pirie, SA. Of the 58 repeater stations that make up the link, 43 operate automatically and unattended. They have a diesel back-up for extended windless periods.

New director for Antarctic

The Department of Supply recently announced that Dr R. I. Garrod has been appointed to the position of Director of the Antarctic Division, and will take up duty shortly. The position became vacant upon the death of the previous Director Mr Bryan Rofe, in August 1971. Dr Garrod has a distinguished record in the fields of physics and scientific administration, and his most recent position was Senior Assistant Secretary of the Science Division, Department of Education and Science, Canberra.

Computer to track steel

The Whyalla steelworks of BHP is to have a computerised tracking and recording system designed to retain the identity of all steel from the time it reaches the mill in ingot form until it is packed for dispatch to the customer.

Basic hardware will comprise a CDC 1700 computer with a memory of 32,000 words, mass drum storage for 980,000 words, 27 data input stations, four conversational displays and automatic devices for measuring length.

Once an ingot enters the mill, the computer will have full knowledge of its whereabouts. If the computer does not receive data (mostly from manual input stations) by a prescribed time it will query the appropriate point and, if necessary, refer the problem to the Production Control section.

It will also have the power to stop production if it concludes that its instructions are not being carried out, and can only be overruled by Production Control.

Fire brigades go UHF

Melbourne fire brigades have a new communications system claimed to be the most sophisticated UHF system in Australia. Their old system, in operation for 30 years, was a mixture of VHF and HF channels.

The new system, installed by Standard Telephones and Cables, Pty Ltd, under a $120,000 contract, has seven base transmitter / receivers controlled from consoles at No. 1 Station, Eastern Hill, working to 140 mobile units and five fixed monitor sets.

Fire crews can talk to one another as well as to base within 30 miles direct or within 60 miles through a series of talk-through repeater stations. The mobile sets are compact, just a little bigger than a portable tape recorder, and use noise-cancelling microphones to reduce background noise and improve voice clarity.

Melbourne Fire Brigade officer operates one of the twin base station consoles at Eastern Hill. All conversations are automatically recorded.

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		Reg.	Zout	Hum	Reg.	Zout	Hum		
207B	10-15V, 12A or 20-30V 6A	0.1%	5mΩ	1mV		N.A.		No	**$255**
216A	0-400V, 200mA & 0-250V, 50mA & 6.3V, 6A	0.002%	5mΩ	1mV	0.05%	10KΩ	4mA	No	**$290**
222	0-400V, 100mA & 0-100V, 1mA & 150V & 6.3V, 4A	0.5%	10Ω	7mV		N.A.		No	**$178**
242A	0-36V, 2A x 2 or 0-36V, 4A or 0-72V, 2A	0.002%	2mΩ	200μV	0.005%	100KΩ	500μA	Yes	**$500**
246A	0-36V, 5A x 2 or 0-36V, 10A or 0-72V, 5A	0.002%	2mΩ	200μV	0.005%	100KΩ	500μA	Yes	**$661**
250B	0-7V, 5A or 7-12V, 3.5A or 11-18V, 2.5A	0.01%	1mΩ	300μV		N.A.		Yes	**$150**
251	0-14V, 2.5A or 14-22V, 1.8A or 22-36V, 1.3A	0.01%	1mΩ	300μV		N.A.		Yes	**$150**
272A	0-12.5V, 2A or 0-25V, 1A or 0-50V, 0.5A	0.001%	1mΩ	100μV	0.005%	100KΩ	100μA	Yes	**$202**
275	0-36V, 2A or 0-72V, 1A	0.002%	1mΩ	200μV	0.005%	100KΩ	200μA	Yes	**$290**

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Toshiba: colour TV only

Production of monochrome TV receivers has ceased at Japan's Tokyo Shibaura Electric Co Ltd (Toshiba). The company's facilities will now be used to produce colour sets and items of higher value. Toshiba announced that it decided to halt production because of rising costs in monochrome TV set assembly. The company had been delivering some 60,000 sets monthly, of which 26,000 were being supplied by the affiliated Onkyo Corporation. Onkyo will continue producing monochrome sets, with a view to expanding markets in South-East Asia.

Isaac Newton — mad as a hatter?

A new theory of why Sir Isaac Newton went off his head for a while, when he was about the age of 50, has been advanced by two American physicists. J.R.M. Seitz, Harvard University, and J. Y. Lettvin, Massachusetts Institute of Technology, say evidence shows that Newton had a classic case of mercury poisoning — known as Mad Hatters disease.

Newton himself described how he worked in closed rooms with large amounts of mercury. The mercury vapour level would have exceeded modern safety criteria by a factor of 1000. His writings also show he was not aware of the toxic hazards involved.

Recent theories have suggested that Newton became mentally disturbed after the death of his mother, but by analysing changes in his handwriting during the period of his illness, Seitz and Lettvin hope to prove he had acute mercury poisoning.

Video discs now in colour

At a recent exhibition in Berlin a full-colour video disc recording was demonstrated by its joint developers AEG Telefunken (West Germany), Decca (UK) and, primarily, their jointly owned company, Teldec. Observers generally agreed that the colour quality was excellent and that the picture produced was completely satisfactory for home viewing.

The video disc uses a simplified colour system based partially on redundancy of information in the TV picture. For low-frequency sections fo the picture (up to about 1MHz), the colour is line sequential — one line red, one blue, one green, and so on. This information is stored and redistributed on each line. The higher-frequency portions of the picture are reproduced unaltered.

The discs are about 8in (20.3cm) in diameter. A black-and-white version, demonstrated in the USA in the latter half of 1970 gave 12 minutes of material. Because of the additional information needed, the playing time of the colour disc is only five minutes. Teldec has also developed a cartridge that can hold up to 30 of the discs, thus giving two hours playing time or more. The makers plan to market discs for the 625-line PAL and SECAM systems, and for the 525-line NTSC system.

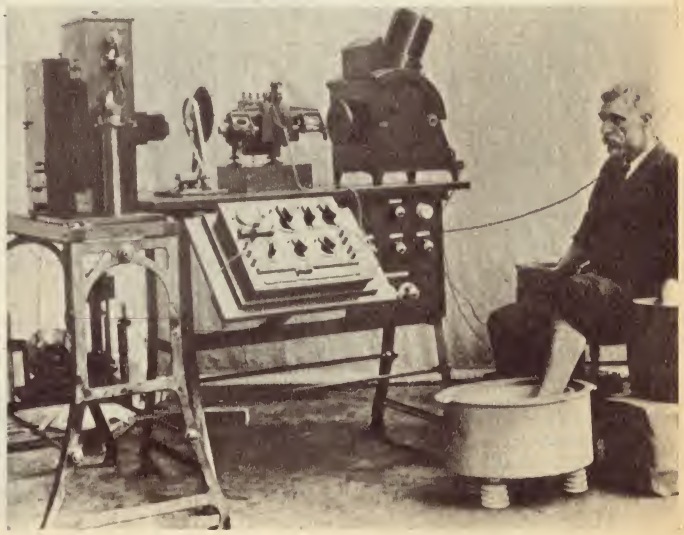
Marketing of the discs and a range of players is expected to start in 1973. The discs are expected to sell for the cost of an audio disc. A simple type of player (expected to sell for about $200) will be slot loaded. The disc, in its jacket, is pushed into a slot, is played, reloaded into its jacket, and automatically ejected. An automatic changer (to cost about $400) will accept discs loaded in a cartridge. It will have two turntables and two pickups — while one disc is playing the next is being deposited on the other turntable ready to continue the performance with only a fraction of a second break.

"Electronics in the A.C.T." conference

The Canberra Division of the IREE Australia will hold a four-day conference at the end of August and in early September, 1972. Theme of the conference will be "Electronics in the ACT". Lectures and discussion groups will deal with a wide range of subjects involving electronic projects being undertaken in the ACT. These range from the control of one of the most powerful magnets in the southern hemisphere, to a description of the 210ft dish aerial at Tidbinbilla. Displays of equipment and components will be provided in an area adjoining the lecture room. Further information may be obtained from the Secretary, Canberra Division, The Institution of Radio and Electronics Engineers Australia, PO Box 1246, Canberra City, ACT 2601.

BOTH MEN LOOK A BIT APPREHENSIVE, but the heart patient shown below appears to have better reasons. He is connected to the world's first electrocardiograph (EKG), introduced by Cambridge Instruments in 1908. His hands and foot are dunked in a salt solution to create good electrical contact with the skin. Note the big ceramic insulators isolating the water tub from the floor.

Sixty-three years later the same group announced another first: a lightweight EKG that transmits the patient's electrocardiogram from a moving ambulance so the hospital can prepare the necessary treatment before he arrives. It will also transmit the information through the hospital's internal telephone system so doctors can keep informed from whatever part of the hospital they may be in.



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CBS drops EVR player

Columbia Broadcasting System has announced that it will not manufacture or market the domestic players which were developed for its EVR video recording system. The manufacture and marketing of the devices will be carried out jointly by Imperial Chemical Industries and the CIBA Corporation (the "EVR Partnership") in Europe. These firms may negotiate with the Japanese concerns Matsushita, Hitachi, Toshiba and Mitsubishi for access to areas other than Europe and North America.

Initially CBS had given exclusive manufacturing licence to Motorola, but this expired at the end of 1971. CBS will retain patent rights for the complete EVR system, and is also free to market EVR program material.

Robot that "feels"

Hitachi Ltd in Japan has completed a prototype industrial robot which is equipped with a mechanical arm and "hand" incorporating a programmed sense of touch. The robot is capable of finding scattered objects, using tactile cues to recognise the form and orientation of the object in order to grasp it securely, changing of the orientation if necessary, and packing a series of objects into a container automatically.

The fingers of the robot hand are fitted with fourteen touch sensors, together with four sensors capable of distinguishing various degrees of pressure. The signals from the sensors are interpreted by the robot's control system and used to control the arm and hand.

Gamma ray mineral survey

A highly sensitive gamma ray spectrometer survey was recently flown across the north of central Australia by Aero Service (Aust) Pty Ltd, a division of Litton Industries. The spectrometer consists of an array of 10 sodium iodide crystals providing a total crystal volume of 1300 cubic inches (2.13 cubic metres). It is used to detect deposits of uranium, potassium and thorium. Fitted to the aircraft recording instruments, the crystals in the spectrometer emit a series of light flashes when passing across radioactive deposits at or just below ground level. The light emissions are detected by a photo-multiplier in the instrument which then records the signals on digital magnetic tape for subsequent analysis.

PRIZE WINNING APPRENTICE ON TOUR. John Ellingham, Victoria's apprentice of the year for 1971, was briefed on Philips new line of process control equipment by Mr. Peter Whitehead during his recent visit to Philips facilities in the Sydney area. John, who is apprenticed to the State Electricity Commission of Victoria as an instrument maker and repairer, was chosen for the honour out of 30,000 apprentices in Victoria.

Colour telecine for QTQ9

Queensland Television Ltd, which operates television station QTQ9, Brisbane, has ordered Rank Cintel flying spot colour telecine equipment from Rank Taylor Hobson Pty Ltd. The equipment, comprising twin film scanners with electronic multiplexing and associated film colour correction units, is to be delivered this year.

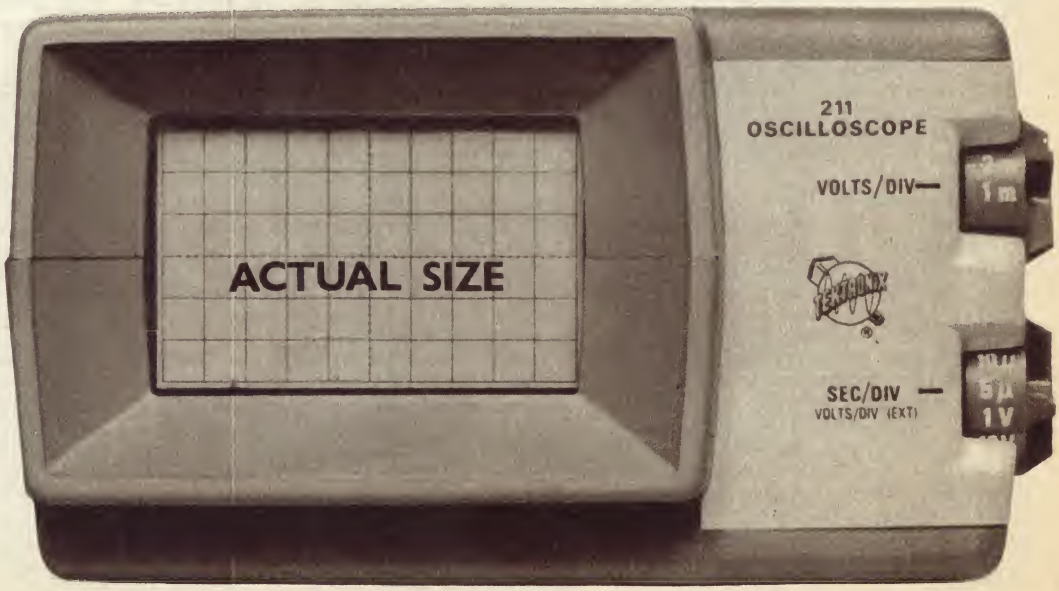
Packard returns to H-P

In December last the resignation was announced of David Packard, who since 1969 had held the important US post of Deputy Defense Secretary in the Nixon administration. Packard was co-founder with William R. Hewlett of the well-known US instrument manufacturer Hewlett-Packard, and had given up a US$1 million a year income to take the modest $42,500 a year government post. He had also put his estimated $300 million personal H-P stockholding into a trust fund designed to prevent him from making income or capital gain from the company while in office.

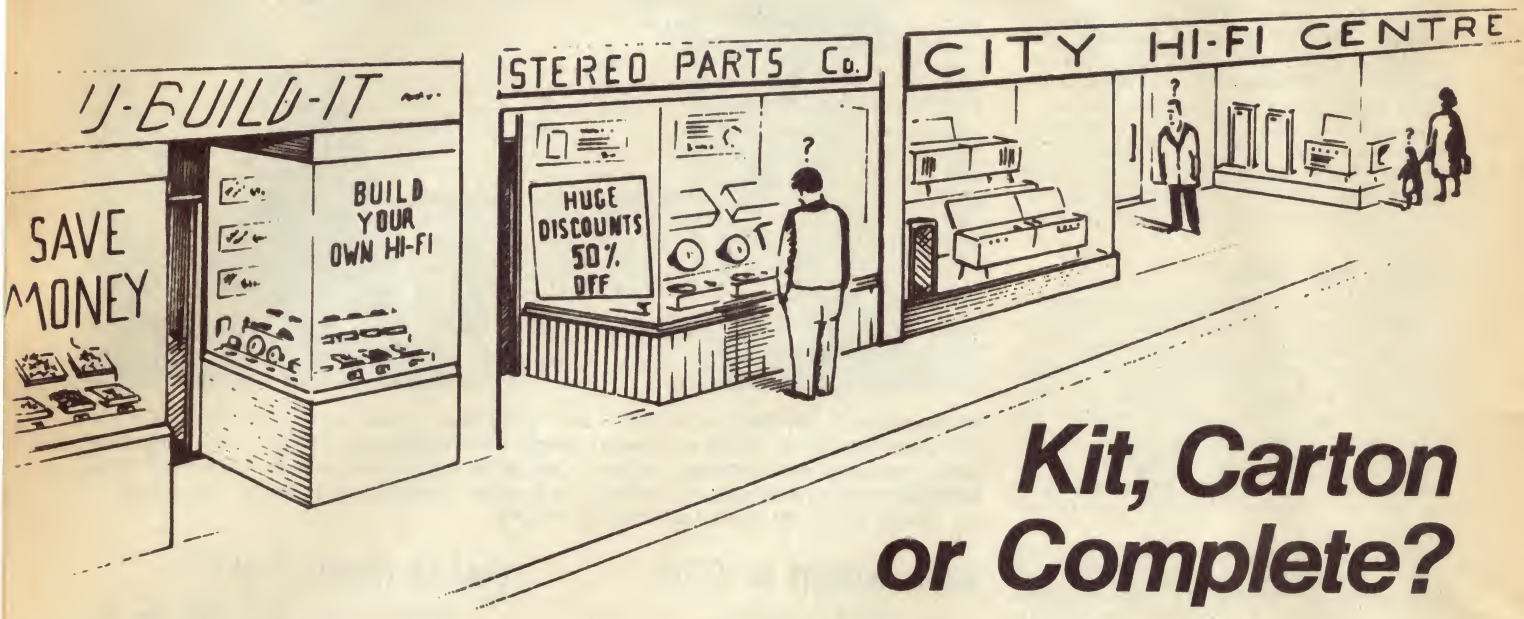
No reason was given for the resignation, although is seems likely that Packard may have become frustrated with the inertia of government bureaucracy.

CRO for the travelling man

Weighing in at three pounds, the new Tektronix 211 solid state Oscilloscope is designed for the field service man. Its specifications match or exceed many larger laboratory CROs, such as a 500KHz bandwidth, IMV/div vertical sensitivity and adjustable triggered sweep. It can be "floated" up to 700V above earth when operating from batteries. Small size was made possible by extensive use of LSI integrated circuits.



How to buy a hi-fi system



Kit, Carton or Complete?

You can acquire a hi-fi system in a variety of ways: You can build it from a boxfull of bits; you can buy the units from clearance or discount houses and string them together yourself; or you can buy the whole outfit from a regular hi-fi dealer. The best approach varies with the individual for reasons which the article explains.

by NEVILLE WILLIAMS

Let's say that you've decided to invest in a high quality sound reproducing system for your home. You will have worked out roughly how much you are prepared to spend, where the system will be placed in the home and the role it will play in everyday family life.

What is said in this article may support or it may challenge those ideas; it really doesn't matter which. Our whole purpose is to assist people who are not fully acquainted with high fidelity equipment to reach wise decisions before they actually commit themselves.

Broadly speaking, there are three main approaches to acquiring high fidelity equipment:

BUILD IT YOURSELF: Build the amplifier from basic components; build the loudspeaker enclosures from raw materials or assembly kits, adding and wiring the loudspeakers, crossover networks, &c; build the record player cabinet, install the motor, arm and cartridge, and wire up. Connect everything together as necessary.

BUY & ASSEMBLE MAJOR COMPONENTS: Buy a standard commercial amplifier in carton; buy complete loudspeaker systems; buy ready-built record player, radio tuner, tape deck, &c. Set them up on shelves, interconnect them as necessary.

BUY A COMPLETE SYSTEM: Arrange with one supplier to provide a complete system, selected on the basis of a showroom demonstration. The supplier installs and tests the system and provides back-up service. You pay the bill and enjoy the result, hopefully with a minimum of worry.

Let's look at each of these propositions in turn, to discover how they meet the needs and capabilities of different individuals.

The urge to build one's own amplifier system is as old as the subject itself. Through the years there has always been a group of people who have preferred home-made units to the commercial product. At some stages the home-made product has been technically ahead of what has been commonly available over the counter. Often there has been a clear price advantage. Always there has been the satisfaction of having built it oneself.

Home construction of high fidelity equipment reached something of a peak on all three counts during the late fifties and early sixties. Electronics magazines were full of amplifier circuits, plans for high fidelity loudspeaker systems, advertisements for kits, and so on. It was during this period that the word "Playmaster" became virtually synonymous in this country with high-quality do-it-yourself hi-fi, as featured in "Electronics Australia" magazine.

This period also saw the beginning of a boom, around the world, in the commercial manufacture of high fidelity components. This has culminated in the current flood of keenly competitive high fidelity components — sufficient to tempt many a would-be homebuilder away from the workbench.

The boom in commercial amplifier production has coincided with the swing away from valves and toward solid state (i.e. towards transistors and integrated circuits). This trend, together with the use of printed wiring boards and other modern techniques has made it possible to produce, relatively easily and relatively cheaply, amplifiers which are far more complex than their earlier valve counterparts.

Once a design has been finalised and prototypes produced, it is now possible to reproduce them on a mass-production basis using largely unskilled labour, automatic machines and automated testing procedures. Complex circuitry and extended user facilities do not add overmuch to production-problems.

As matters have transpired, this approach has put the home constructor at a disadvantage, if he has any idea of competing with the more sophisticated commercial products. Those who seek to develop complex equipment for ultimate home construction face a major task in evolving the original design, and in reducing it to easy-to-follow instructions and diagrams for a magazine or a brochure. Similarly, those who market the necessary components face a major task in collecting the numerous individual items and providing metalwork and decorative items to an acceptable standard.

The smaller and more scattered the anticipated market, the larger do these

problems loom. For these reasons, they are much more serious in Australia than they are, for example, in Britain and America.

These problems aside, when the plans and the parts are finally to hand, the home-builder faces a considerable task in sorting everything out, avoiding errors in selecting and positioning components, and following through the various assembly steps.

If everything works out as it should, he will finish up with an amplifier which will perform as intended. He will have the satisfaction of having built the unit himself and of having saved some money in the process.

But what if the amplifier doesn't work for one reason or another?

If the constructor is versed in electronic theory and practice, he won't worry overmuch. He will analyse the problem and rectify the fault without too much delay.

On the other hand, if he has been following a plan blindly and ends up with a complex amplifier which does not work, or does not work properly, he has a real problem on his hands. The overall complexity, and the inaccessibility of components soldered to printed wiring boards are a major deterrent for the amateur troubleshooter; equally, they will also slow up a professional who is called in to service a piece of equipment that he has never seen before.

In short, the construction of a modern, complex high fidelity amplifier is primarily a project for experienced homebuilders — people who are familiar with components, techniques and the theoretical background of what they are undertaking. Less experienced enthusiasts should get involved only if they can count on ready assistance from someone with the necessary background.

In saying this, it must be acknowledged that project kits are marketed by certain companies who specialise in the field. The kits are traditionally complete down to the last nut and bolt and are accompanied by books which detail every single step in the construction. Theoretically, they can be put together by someone having no previous experience whatever, and there is a back-up service for anyone who gets into difficulty.

Kits like this are fine in their home markets — England and America for example. However, before becoming involved here, it is wise to make sure that the kits and instructions are appropriate for Australia and that back-up assistance is available, should it be necessary.

Home construction of loudspeaker systems is a quite different matter. It is largely an exercise in cabinet fitting, requiring no more than ordinary handyman skills. The constructor's obligation primarily is to follow instructions about materials, dimensions, rigidity, sealing, &c. And, of course, the recommended louspeakers must be used if the anticipated results are to be achieved.

The least demanding approach to a home-made loudspeaker system is to work from a pre-cut cabinet kit, as recommended by a reputable hi-fi dealer. A good kit will go together with a minimum of additional work and should closely approximate the commercially finished product. Modern materials and the trend to oiled finishes fortunately pose much less of a problem for the handyman than the full-gloss finish that was favoured a few years ago. The handyman who builds up a loudspeaker kit is likely to save quite a few dollars, as compared with the finished item.

An even greater saving may be possible for the handyman who can work from raw materials, particularly if the materials can be obtained as "seconds" or off-cuts. While the system will sound well if the instructions are followed, the finish will depend almost entirely on the skills of the handyman.

Mounting of the motor and pickup is another area where the handyman can substitute effort for outlay. Greater care is necessary, however, because a motor and pickup mechanism is more subtly prone to damage through inadvertent mishandling than loudspeakers and associated components. It is wise to talk this over with the hi-fi dealer before making any decisions to "roll your own".

So much then for the home construction of hi-fi equipment. What about the idea of buying the major components from different sources and wiring them together in the home?

This approach follows a fairly common pattern:

The enthusiast avidly reads advertisements and reviews; talks to salesmen in hi-fi shops; listens to equipment wherever he can. He gradually narrows his selection to two or three possible amplifiers, loudspeaker systems, pickups, motors, &c. This done, he seeks out the best "deal" for the items, collectively or singly, from hi-fi dealers, clearance houses, discount houses — in fact, from anybody who will sell!

Ultimately, all the items are collected, taken home and connected together. The enthusiast relaxes, hopefully a happy man.

Funny! I could've sworn that I had R16 a moment ago!

This approach may well pay off in terms of the total expenditure. It is a fairly obvious course to follow for the enthusiast who has adequate knowledge, limited funds but no time or incentive to build his own. He will be able to recognise the quality product which is being sold off, perhaps because it lacks the embellishment of the latest model. He will be able to separate the genuine bargain from the dressed-up "cheapie".

No less important, he will be able to anticipate and avoid possible problems of compatibility; he will be able to interconnect the equipments as necessary, and cope with any problems that might arise.

On the contrary, the enthusiast who lacks the necessary technical knowledge or guidance is well advised to avoid the bargain hunting approach, and with good reason.

Problems of compatibility can arise between items which may, individually, be of acceptable quality.

Certain cartridges may not easily fit into certain pickup headshells. Some pickup arms may not associate easily with certain turntables, because of height or mounting postion.

Cartridges which are sensitive to magnetic fields may give trouble with players having a somewhat greater hum field than others. Because of magnetic attraction, some cartridges are best not used with steel turntables.

Cartridges which happen to produce above average peak output should not be used with amplifiers having below average tolerance to input signal.

Particularly sensitive loudspeakers may emphasise the noise and hum content in an amplifier, whereas the same amplifier could be acceptable with loudspeakers of lower sensitivity.

Again, an amplifier somewhat lacking in power output and sensitivity might sound normal with sensitive loudspeakers but disappointing with insensitive types.

And so on.

Problems like this can be very serious indeed for the non-expert. Without understanding the reasons, he knows only that the equipment, assembled at considerable cost, is not satisfactory.

He may blame the amplifier but the vendor is likely to insist that the amplifier is above reproach. Is it not a standard model which has been made and sold by the thousand? The trouble must have to do with the cartridge or the loudspeakers!

Most likely, much the same reaction will be had from the other suppliers:

Nothing to do with the cartridge; it's an amplifier or loudspeaker problem!

Nothing to do with the loudspeakers; it's a cartridge or amplifier problem!

Taking a charitable view, the individual suppliers may be quite sincere in their statement, because they will not necessarily know that there is some basic incompatibility between their unit and another item that they know virtually nothing about. And, even if they offer a substitute unit to demonstrate their good faith and the quality of their merchandise, it will not correct the situation if the basic incompatibility remains.

Taking a less charitable view, vendors of individual packaged components may simply not be willing to extend themselves to help a customer in trouble. They are concerned with only a portion of the overall system and, in a "deal" situation, their profit margin from that portion may leave nothing for after-sales service.

Is this an unduly black picture?

Some may think it is — particularly those who have bought hi-fi equipment this way, put it together without any bother, and saved themselves quite a few dollars in the process!

The basic purpose of these remarks is not to rule out "carton" deals but simply to stress that, when the customer walks out of the various shops with his purchase, he is very much "on his own." If he can cope with problems that might arise, he has nothing to

worry about. If he can't, the dollars saved might easily be offset by having to seek professional assistance.

In some respects, there is a close parallel between carton buying on the local market and bringing items back from overseas.

With the increase in overseas travel, many more people have had the opportunity of shopping in duty-free areas adjacent to Australia, notably Singapore, Hong Kong and Fiji. The emphasis in such buying tends to be on tape recording and replay equipment, though other items can be bought to advantage by dint of more diligent searching and bargaining.

The would-be enthusiast, keen to shop for hi-fi equipment overseas, should be careful to do two things beforehand:

1. Identify the kind of equipment that he wants, before leaving Australia, noting in his pocket diary the figure he would have to pay locally for each item. Once overseas, the pressures of travel, bargaining and currency conversion are great enough, without having to rely on memory for the Australian price levels.

2. Before leaving Australia, obtain a traveller's guide sheet of current customs and tariff regulations; study them and seek clarification where necessary from a customs officer at the point of departure. This done, sit down and work out what you can or cannot bring in duty-free. If you anticipate having to pay duty, work out the price level at which you will have to buy the various items to come out sufficiently "in front" to justify the time and trouble involved — not forgetting packaging, freight or excess baggage charges and the collection formalities at this end.

By and large, the customs regulations are biased in favour of small, portable tape and record playing equipment. They are biased against larger, more expensive items of the non-portable variety, particularly if they get into the "radiogram" area, combining a radio tuner with record or tape playing facilities.

These are mainly financial considerations, which must be the subject of decision by the individual concerned, having in mind what he wants, what he can buy overseas, how easy or otherwise it will be to despatch and collect, and the likely obligations in regard to customs duty and sales tax.

Technically, matters of compatibility must be considered, as outlined earlier. The overseas buyer must also make quite certain that the products are intended for, or adaptable to, operation from Australian power mains at 240VAC, 50Hz. Both figures are important, particularly in respect to the speed of turntable or tape recorder motors which are usually dependent on the mains frequency.

The wise buyer will favour brands — and preferably models — which are marketed in Australia. Spare parts and service information can be a problem for models which have not been released through the Australian distributor.

One final point: Understandably, local distributors are not amenable to supporting guarantees or rectifying faults gratis in equipment which has not passed through their own distribution network. Therefore unless the item carries a manufacturer's guarantee which is unconditionally valid and binding on the Australian distributor, don't expect free service if something goes wrong shortly after purchase.

Service may be available but at a price!

At this point it may be appropriate to summarise what has been said and to draw an important conclusion:

IF you do not have the expertise to build your own hi-fi equipment and . . .

IF you lack the background to cope with the possible problems of buying or importing separate carton items . . . .

THEN you would be wise to put yourself into the hands of a reputable hi-fi retailer or a specialist adviser in a reputable department store. Buy the complete system from the one source unless there is a very strong reason for doing otherwise.

Not by any means does this imply that hi-fi dealers as a class are particularly virtuous or altruistic, or that they know all the answers in the technical sense.

To be entirely realistic, they are in business to make a profit; they are salesmen rather than technicians; they have strong personal and business allegiance to certain types of equipment; they have the ability to be "impartial" to their own advantage!

But . . . and it is a very big but . . .

Reputable and established hi-fi dealers want to stay in business. They have to rely heavily on good customer relationships, and word-of-mouth recommendations.

If a customer has a problem, it is in the dealer's interest to put it right.

Technically, any one dealer is not likely to know all the problems of compatibility of the type mentioned earlier in this chapter.

But dealers certainly will know the combinations of their equipment which ARE compatible and which DO work well.

They will know what combinations make sense, economically. They are well placed to advise how the intended outlay should be apportioned between the various items.

No less important, a dealer is likely to know the reliability record of the items which he handles. A particular item may give superb results on test but this is small comfort if the failure rate in service is inordinately high.

Akin to this is the cost of service and, in the case of pickup cartridges, the cost and possible inconvenience of providing replacement styli.

So then, our advice to those without a substantial technical background — and therefore to the majority of would-be hi-fi enthusiasts is simply this: Select a dealer who seems qualified to advise, who can offer suitable equipment at a suitable price, and who can offer effective back-up service. Buy all your equipment from that dealer, or a sufficient proportion of it to ensure that he will put his reputation on the line.

How best to select such a dealer is, of course, the hard question. One way of answering it is to suggest how not to react:

Don't make up your mind on Friday night to buy a hi-fi system, then race in on Saturday morning and make an instant decision.

The best plan is to make haste slowly.

Listen to as many hi-fi systems as you can manage, both to confirm your own requirements and to become familiar with what is or is not within range of your pocket.

Watch the advertisements and read up on hi-fi literature, without necessarily getting bogged down in theory that is beyond you.

But, most of all, talk to people who own hi-fi equipment and ask where they bought it. Was their supplier helpful? Did he install the equipment properly? Has he provided back-up service?'

Beware of dealers who rate a "no" answer.

Be favourably disposed towards those who are credited with giving the customer a "fair go".

The chances are that, if you reach a decision based on inquiry first and then on your own observation, you won't go far wrong.

NEW SELF-CONTAINED DOLBY UNIT

One of the latest developments in the improvement of high fidelity sound reproduction is the Dolby noise reduction system. But up till now, the advantages of the Dolby system have only been available in a few relatively expensive reel-to-reel and cassette tape recorders.

The audio enthusiast who already possesses a high-quality tape recorder can now have the advantages of the Dolby system without purchasing a completely new machine. Pictured above is the Marlux DS100 Dolby adaptor which can be used with any stereo tape recorder or cassette deck having high level (100mV to 1V) inputs and outputs.

Using Dolby "B" circuitry, the adaptor reduces hiss and other high frequency noise by as much as 20dB. Recommended retail price is $189 and the unit will be available from retail outlets throughout Australia. Australian distributors are International Dynamics (Agencies) Pty Ltd, 23 Elma Rd, North Cheltenham, Vic.

Crystal locked HF receiver

by GEORGE HUGHES

Here is a receiver designed for use on specific HF communications or broadcast channels. Crystal controlled, it may be used on any number of channels for which crystals can be provided. Designed around the TAA840 IC it is cheap and easy to build.

There are many uses for such a receiver, some of them at professional and semi-professional level. Those organisations which already operate communications sytems in the HF band, such as bushfire brigades, boat clubs, outback residents within the "flying doctor" network etc, often have need for extra receivers to monitor their channels. This little set would seem to be an ideal unit for the job.

It should be borne in mind that there are certain legal requirements to be satisfied before such receivers can be used. Even an organisation licensed to operate a network will require PMG approval before additional receivers can be used. For people outside the network, it is unlikely that a licence would be granted to monitor a channel except in very special circumstances.

However, there are still many applications where these requirements do not apply but where a fixed tuned receiver would be useful. There are several frequency and time standard transmitters scattered throughout the world — including Australia — and our receiver would be a logical choice for monitoring them.

Another obvious application is to monitor the various university radio transmitters. We are often asked for a receiver which will operate exclusively on one of these channels, and this design would seem to be the answer.

Again, certain overseas or local short-wave broadcast stations may interest individuals to the point where they would be happy to be able to monitor the channel with a high degree of reliability.

The receiver is designed around the TAA840 IC, a unit originally intended as the major portion of portable broadcast receivers, and requiring a minimum of peripheral components to make it work.

Since the introduction of the TAA840, many people have experimented with it to find if it is suitable for HF reception, up to, say, 15MHz.

Experiments have shown that the oscillator section of the IC restricts operation beyond the broadcast band, but that it is capable of working well into the HF band if it is provided with an external oscillator.

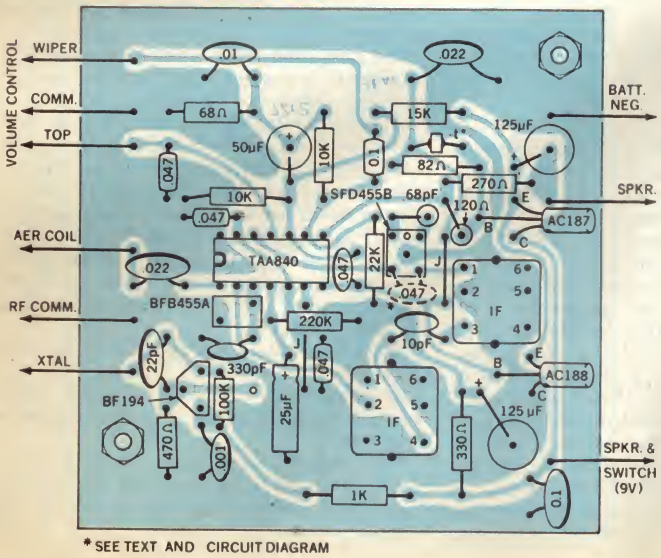
Among the experimenters was Mr. Maurice Findlay and his associates of Findlay Communications Pty Ltd of Ryde, NSW. We are indebted to Mr. Findlay for the information supplied, resulting in the receiver described herein.

On consulting Philips for information relative to highest frequency operation of the IC with an external oscillator, it was felt that it could possibly achieve an upper limit of at least 14-15MHz, but no data was available to confirm this. It was suggested that the limiting stage would be that originally used as the oscillator but which, under the new arrangement, becomes the mixer.

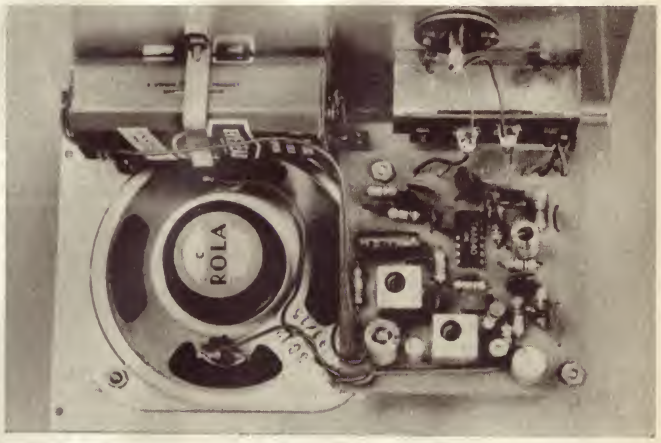
Apart from the external oscillator and the IF system, the TAA840 applications information circuit was followed. A few alterations to circuit values allows it to be operated from a 9 volt battery.

So much for the general aspects of the unit.

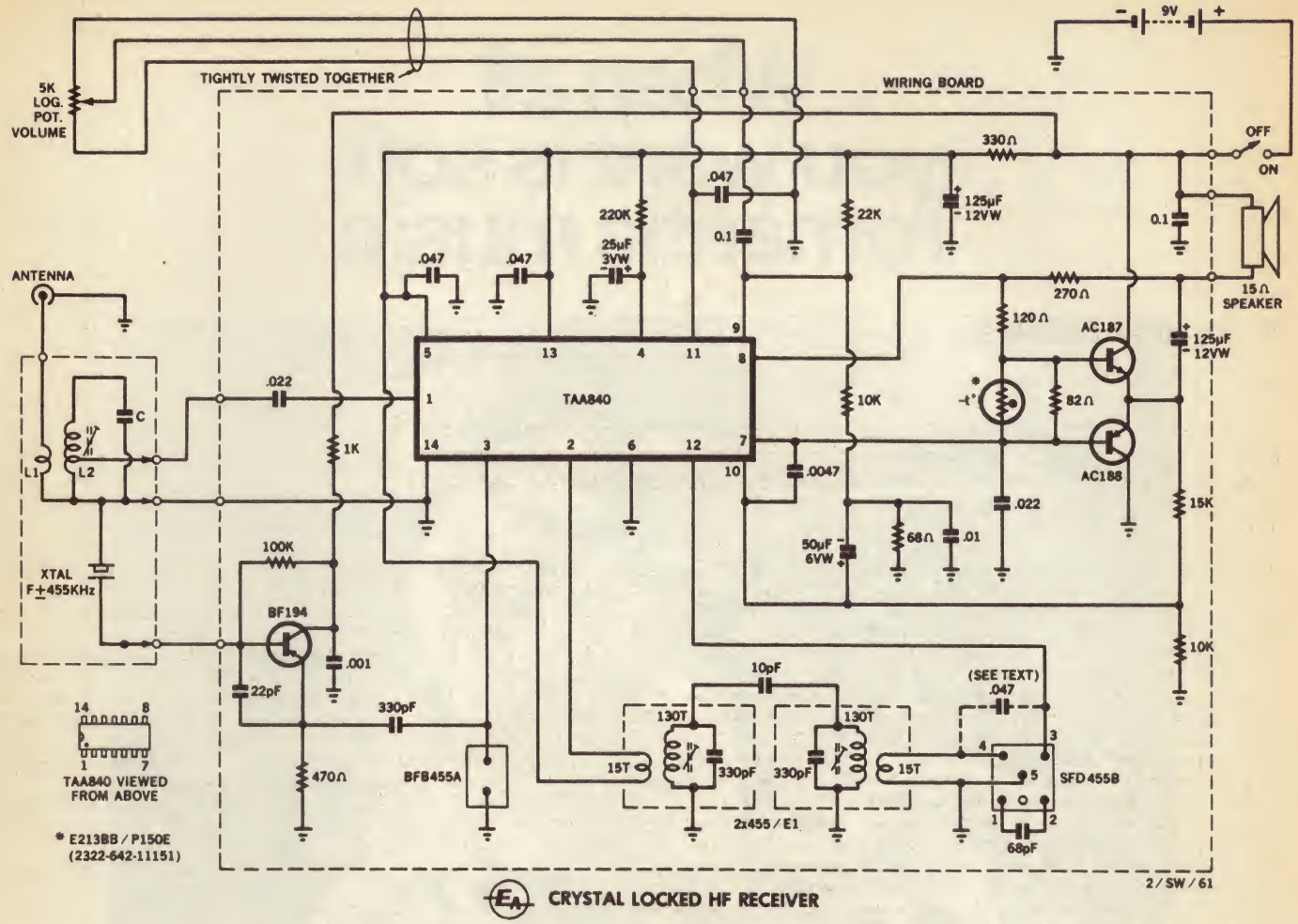
A brief description of the circuit will help the reader appreciate how the set functions. The aerial feeds into a conventional tuned circuit, except that it is a fixed tuned arrangement, adjusted to suit the selected crystal. The crystal and tuned circuit may be contained in a plug-in module, if more



* SEE TEXT AND CIRCUIT DIAGRAM



Layout diagram at left shows how the components are positioned on the printed wiring board (as viewed from the component side). Rear view of front aluminium panel, above, shows position of crystal module and aerial socket at upper right.



CRYSTAL LOCKED HF RECEIVER

than one channel is to be monitored.

The BF194 transistor functions as a form of Pierce oscillator in conjunction with the selected crystal. This oscillator will operate over a wide range of frequencies, by simply plugging in the appropriate crystal. Output is taken from the emitter and coupled to pin 3 of the IC via a 330pF capacitor.

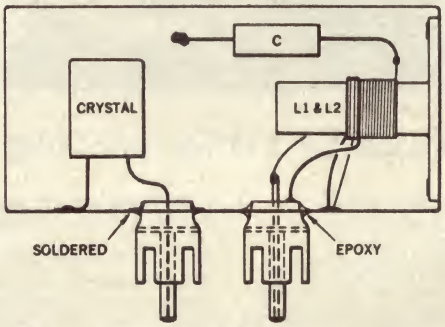
Also coupled to pin 3 is a ceramic filter resonant at 455KHz. Within the IC pin 3 connects to the emitter of what is now the mixer transistor. The ceramic filter, which has minimum impedance at resonance, functions as bypass across a 2.2K resistor in the emitter circuit, and makes it better able to handle signals at 455KHz.

Pin 2 is the collector of this same transistor, and connects to the external IF components. These consist of two IF transformers, top coupled, and another ceramic filter. Output of the filter goes back into the IC at pin 12. A volume control connects between pins 9, 11 and common, and the audio is taken from pin 7 and fed to a complementary — symmetry pair, AC187 / AC188.

(A circuit of the IC appeared on page 55 of the February 1971 issue.)

On the construction side, the whole receiver is assembled in a small, sloping-front instrument case. Layout can be judged from photographs of the prototype.

The circuit board carries almost all components closely associated with the operation of the IC. Components external to the board are the aerial tuned circuit, crystal, loudspeaker, volume control, and off / on switch.



Plug-in crystal module showing position of components and phono plugs.

In the prototype, we mounted the aerial coil and crystal in a small metal box so that channel changing could be achieved simply by plugging in a suitable pretuned module.

Readers may have their own ideas on channel selection, and we leave this portion of the construction to the individual's ingenuity. One alternative arrangement could use a miniature rotary switch, selecting the desired number of coils and crystals. For single channel operation, a single coil and crystal could be wired in permanently.

Whatever system is used, make sure that leads are kept short and that there is a metal screen between the aerial coil and the crystal. This is necessary to minimise the risk of instability, particularly at the higher frequencies.

For readers who wish to duplicate our module arrangement, connection is made to the receiver circuit by a dual "phono" connector strip available from Watkin-Wynne or their distributors. The module itself carries two phono plugs mounted at the same centres as the connector strip (½in). One is soldered directly to the module box, and the other insulated from it in an oversize hole and fastened with an epoxy such as "Araldite".

This provides four connections to the module. The crystal is connected to the soldered phono plug, the centre pin being the "hot" lead to the base of the oscillator transistor. The shell of the same socket is used for the crystal common return and the coil common return. The aerial coil is connected to the insulated phono plug; the tapping to the pin, and the aerial input lead to the insulated shell. The aerial input socket is a similar type of single phono plug mounted on the front panel.

The aerial tuned circuit consists of a fixed capacitor and an adjustable coil wound on a Neosid former with adjustable core. The coil is mounted so that the core is accessible through a hole in the side of the module. The winding is closewound with enamel wire to

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BA1371A

IF AND AERIAL COIL DATA

IF Coils:
Neosid type "E" adjustable inductance assembly.
Winding wire: 36B&S DTE.
Windings: Resonant: 130 turns.
Coupling: 15 turns.

Aerial Coils:

Former: Neosid type 3511; Core: Neosid 6mm x 12mm, "500" grade.

f	L1	L2	C	Wire
2-3MHz	3 turns	40 turns, tap at 5 turns	220pF	34B&S
3.7-5MHz	as above	as above	150pF	as above
4.4-6MHz	as above	as above	100pF	as above
5.8-8MHz	2 turns	15 turns, tap at 2 turns	270pF	28B&S
7.8-11MHz	as above	as above	150pF	as above

L1 to commence at end nearest mounting flange, and placed approx 3mm from this end. L2 to be wound over L1.

HF Receiver, Cont.

the specifications given in the accompanying table.

Although we have shown data for only two aerial coils, the choice of capacitor value will allow any frequency from 2 to 11MHz to be covered. With a lower value capacitor, it may be possible to extend the frequency up to 15MHz or so.

If separate aerial coils are wound to cover these higher frequencies it would be advisable to select a grade 900 core for the coil former. The grade 500 specified is intended for use only up to about 10MHz.

If you wish, you can make your own IF coils to the data given, or you can purchase these ready-made from Findlay Communications Pty Ltd, 2 Pope St, Ryde, NSW 2112.

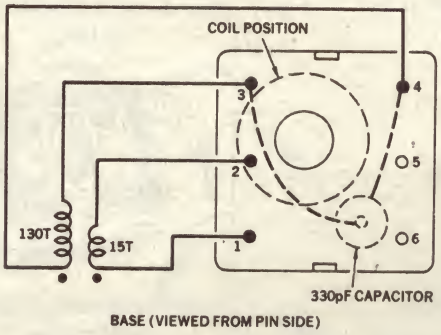
The IFs are scramble wound on small Neosid "cotton reel" type E cores, assembled with a small cup and threaded tuning cores.

With the aerial coil data specified, the sensitivity for 50mW in the speaker was of the order of 1.5uV. This may vary slightly between individual ICs, but is adequate for most situations. With increase of RF input, the AGC control was within specifications of the IC data.

As we said earlier, there is very little information available as to the highest frequency at which these ICs will work. If a particular unit will not work up to 14 or 15MHz, it may be worthwhile to select a different IC. A batch identification code is usually placed in small letters under the type number and one from a different batch may work better.

The crystal frequency should be the signal frequency plus or minus the IF. This may present a problem in some cases, since the actual IF will be determined by the response of the particular SFD455B ceramic filter. These are made to a nominal 455KHz, but with a tolerance of plus or minus 2%.

Ideally, the IF filter frequency characteristics should be quoted when ordering a crystal, but very few constructors have the equipment to measure the natural resonance of the ceramic filters with the accuracy necessary to order a "spot on" crystal.



Position of components and base connections for IF coils.

In these cases, there are one or two tricks that can be employed to minimise possible errors. One is to "pull" (shift) the crystal frequency by a small amount.

"Pulling" can be achieved, within limits of reliable oscillation, by inserting capacitance in series with the crystal to slightly increase its frequency, or in parallel to reduce its frequency. A small air trimmer can be used for this.

A more complete solution, at some cost in selectivity, is to eliminate the SFD455B filter. This will allow the IF response to be determined by adjustment of the remaining IF transformers. The crystal can then be ordered on the basis of a 455KHz IF, the IF channel being ultimately adjusted to this on the basis of best reception of the signal. Subsequent crystals could be ordered on the same basis.

The ceramic filter is eliminated by bridging the output of the tunable IFs to the input of the IF amplifier (pin 12) with a 0.047uF ceramic disc capacitor. (Shown dotted in the circuit) The effect of the BFB455A ceramic filter can be neglected in these circumstances.

Another decision to be made before the crystal is ordered is whether it should operate on the high or low side of the wanted signal. While either will work equally well, the matter of possible images must be considered. Particularly at high frequencies, the simple aerial tuned circuit may not be able to reject a powerful signal which could be located 910KHz (twice the IF) away from the wanted signal.

For example: If the wanted signal is on 10MHz the crystal could operate at either 10.455 MHz or 9.545 MHz. Working at 10.455, the image would occur at 10.910, while working at 9.545 would put it at 9.090MHz. If there was a powerful signal on either of these two image frequencies it would be wise to select the other one.

If a signal generator is available it could be used as a substitute for the crystal, temporarily, to allow both image conditions to be investigated. When a decision has been made, the crystal can be ordered.

The only type of crystal which will work reliably in the Pierce oscillator circuit is one cut for the **fundamental** mode. "Overtone" cut crystals may or may not operate in the circuit. If they do, they will operate on their fundamental, which will be approximately some odd sub-multiple of the figure stamped on the case.

There should be no difficulty in obtaining fundamental crystals up to the likely limit of this receiver. In fact fundamental crystals can be supplied up to 40MHz, although they are quite fragile. Up to 15MHz there are no special difficulties.

Crystals, if bought new, should ideally be "wire in" types when used in either the module or wired to a rotary switch. This obviates the use of crystal sockets, which can take up more room than necessary. There is no hard and fast rule to this, but it makes handling of components that much easier.

Assembly of the receiver should not present any problems. Drill all large and small holes for mounting and controls in the panel. Cut holes as necessary for the speaker, and module (if used).

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Mount the speaker on the panel with a piece of expanded aluminium or fabric between. Mount the volume control (with its shaft shortened for an appropriate knob), the on/off switch, aerial connector, and two 1in circuit board pillars.

Assemble the circuit board starting with the IC and smaller components first; then the flying connecting leads to the volume control, speaker, battery and switch; and finally, the module connector. Care should be exercised in orientation of the IC on the circuit board. Damage to the circuit board and/or the IC may result if the IC is soldered in place and then has to be removed. To this end, an arrow indicator is etched in the foil of the circuit board, and the corresponding notch on the topside of the IC at one end should be at the arrow head (see printed wiring pattern) between pins 1 and 14.

Mount the completed circuit board on the brass pillars and connect the flying leads into circuit. Check for shorts, etc.

If everything is ship-shape, a rushing sound should be audible in the speaker when the receiver is switched on, and should be variable with volume control setting.

Alignment should be relatively simple. It will be a little easier if a signal generator is available, but this is not essential. If a generator is available, it should first be used to adjust the IF transformers. The generator is fed into pin 1 of the IC via a 0.1uF capacitor. Connect an output meter, or multimeter on the low AC range, across the speaker terminals.

Feed in a signal at approximately 455KHz. The exact frequency will be determined by the second ceramic filter, and the idea is to set the two transformers so that they are at the same frequency as the filter. Final adjustment is to the aerial circuit, which may be set approximately by means of the signal generator, and precisely when the wanted signal is received. Output from the generator should be kept at a minimum at all times, and the volume control of the set advanced to maximum.

If the circuit has been built without the ceramic filter, the generator should be set as close to 455KHz as possible and the IF transformers adjusted to this. When the wanted signal is received, the transformers can be touched up for best results.

If no signal generator is available it will be necessary to wait until it is known that the wanted signal is available and then adjust the IF and/or aerial coils until the signal is received and brought to maximum strength. Ideally, the aerial circuit should be adjusted with the set connected to the aerial with which it is to work.

Finishing the receiver off is simply a matter of placing the whole assembly into its plastic cabinet and inserting the four anchoring screws in the appropriate positions.

Parts List — Crystal Locked HF Receiver

1 Plastic cabinet with front panel (Watkin-Wynne).
1 3 inch 15 ohm loudspeaker.
1 9 volt battery (Eveready 2362 or similar).
2 Connectors for above.
1 Circuit board (72/r2).
2 IF transformers (Findlay 455E/1), or
2 Neosid type "E" adjustable inductance assembly, 36B&S DTE wire, and two miniature 330pF capacitors (Ducon DFB 112 or similar).
1 Neosid former type 3511 with 6mm x 12mm 500 grade core and 34B&S and/or 28B&S DTE wire for aerial coil.
1 Murata SFD455B filter unit (IRH). (See text).
1 Murata BFB455A filter unit (IRH). (See text).
1 AC187/188 complementary transistor pair.
1 TAA840 integrated circuit.
1 Phono receptacle. (Cinch 733-23-2).
3 Phono plugs (Cinch 691-10-1).
1 Dual phono receptacle assembly. (Cinch 733-23-10).
1 Miniature single pole toggle switch.

RESISTORS (½ watt)

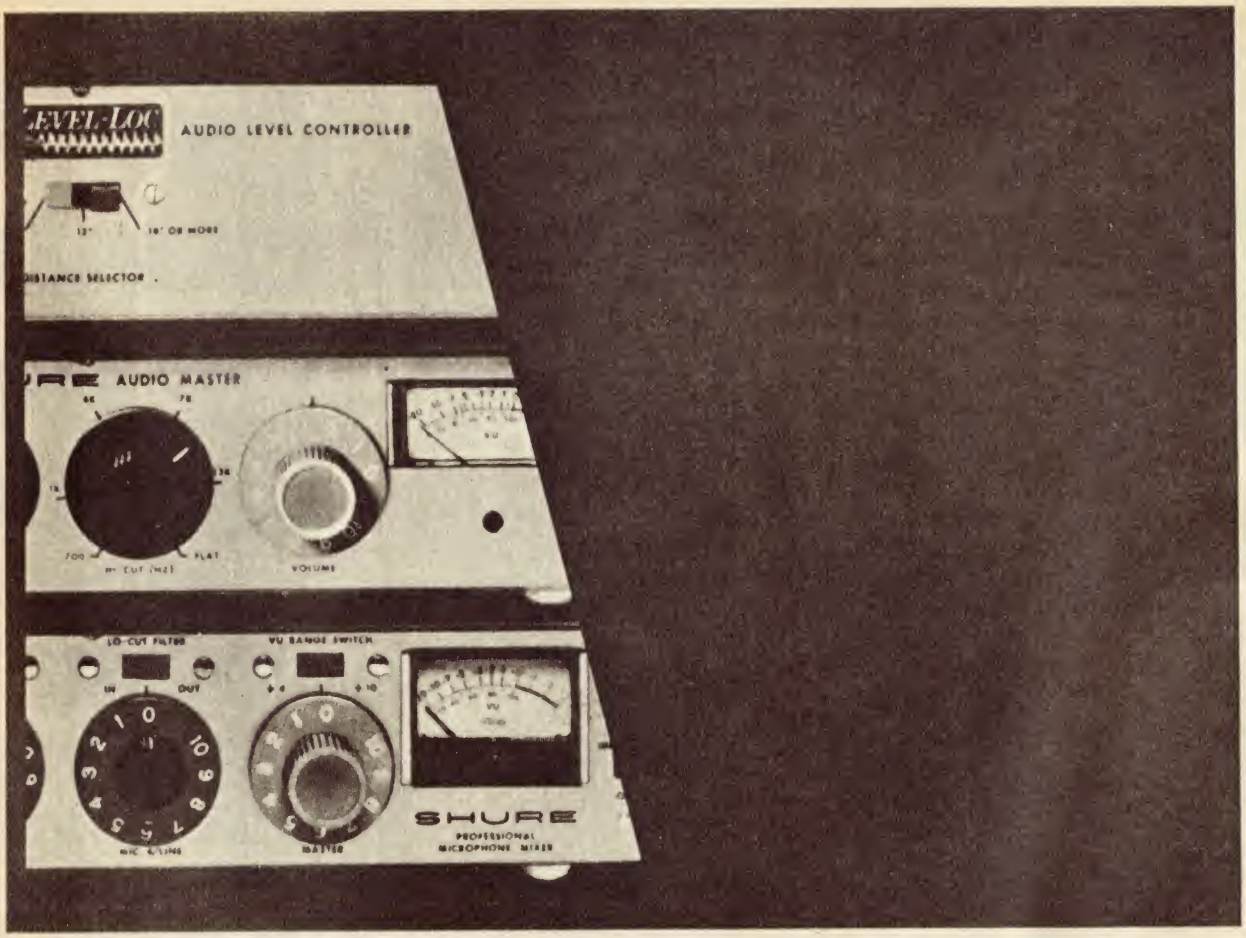
1 220K
1 100K
1 22K
1 15K
2 10K.
1 1K
1 470 ohm
1 330 ohm
1 270 ohm
1 120 ohm
1 82 ohm
1 68 ohm
1 150 ohm thermistor (Philips E213BB/-P150E. Catalog No. 2322 642 11151).
1 5K potentiometer, curve C (log).

CAPACITORS

2 125uF 12VW
1 50uF 6VW
1 25uF 3VW
2 0.1uF ceramic or polyester.
3 0.047uF ceramic or polyester.
2 0.022uF ceramic or polyester.
1 0.01uF ceramic or polyester.
1 0.0047uF ceramic or polyester.
1 0.001uF ceramic or polyester.
1 330pF miniature polystyrene (Ducon DF-B112 or similar).
1 68pF NPO ceramic.
1 22pF NPO ceramic.
1 10pF NPO ceramic.
Polystyrene capacitor(s) to resonate aerial coil (see coil data).

Crystal(s) to suit desired channel (see text).
Small control knob. Hookup wire. Expanded aluminium or suitable speaker fabric. Metal strip for battery clamp. Nuts, bolts, brass pillars, etc.

Note: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may also be used in some cases, providing the ratings are not exceeded.



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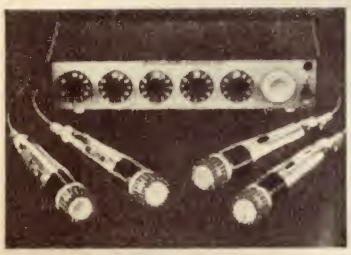

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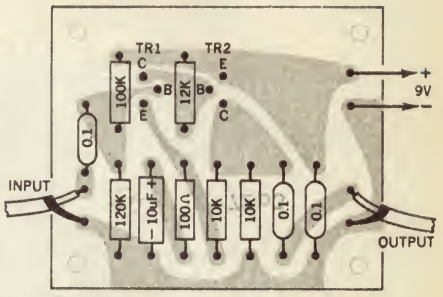
Microphone Preamp with adjustable bass response

Need a compact microphone preamplifier for your stereo amplifier or other equipment? Here is the ideal unit, a 2-transistor circuit on a printed board 2½ x 2⅛ inches. It has a voltage gain of 100 and a current drain of less than 0.5mA. The bass response may be adjusted to optimise speech clarity.

by LEO SIMPSON



Many uses can be found for this versatile microphone preamplifier circuit. It was developed to fill the requirements of a friend of the author and we decided the end result was so handy that many of our readers would want to build it. It would be just the thing for adding a microphone input to your stereogram for sing-along at parties. It can also be used in PA and guitar amplifers, in transmitters and tape recorders.

Later in the article we give details of modifications to the feedback loop to give variable bass roll-off. This improves the overload capability and clarity of reproduction for speech work.

A conventional circuit configuration is used. An NPN and PNP silicon transistor are connected together in a direct-coupled feedback-pair arrangement with both transistors operating as common-emitter amplifiers. Negative AC DC feedback is applied from the collector of the PNP transistor, Tr2, to the emitter of the NPN transistor, Tr1, via a 10K resistor. The ratio of the 10K resistor to the 100 ohm resistor in the emitter circuit of Tr1 sets the voltage gain of the circuit to 100.

Input impedance of the circuit is close to 50K, set by the parallel combination (to the input signal) of the bias resistors for Tr1. As such, it is suitable for dynamic microphones requiring a load of 50K. It can also be used to follow low output impedance FET preamplifiers for condenser microphones.

Microphones are connected to the circuit via shorting type jack socket, as shown in the circuit diagram. This shorts the input to the negative supply line when not in use so that residual noise is greatly reduced from what it would be if the input was left open-circuit.

The output load for the preamplifier should be 20K or higher. Lower values will load the circuit excessively and increase distortion. The voltage gain may be reduced if necessary by increasing the value of the 100 ohm resistor. This will also have the effect of improving the distortion, overload margin and signal-to-noise ratio. Conversely, the gain may be increased by reducing the value of the 100 ohm resistor but the other performance parameters will be degraded.

As it stands, the circuit is intended for battery use. At a current drain of 450 microamps, an Eveready 216 9V battery will last a long time — approximately shelf life. But there is no reason why it should not be run from the supply rail of the amplifier or other equipment into which it is incorporated. Simply replace the 0.1uF supply bypass capacitor on the board with a 50uF / 12VW electrolytic type (higher voltage ratings may be used if size is not a problem) and calculate the required value of dropping resistor. Use the following formula:

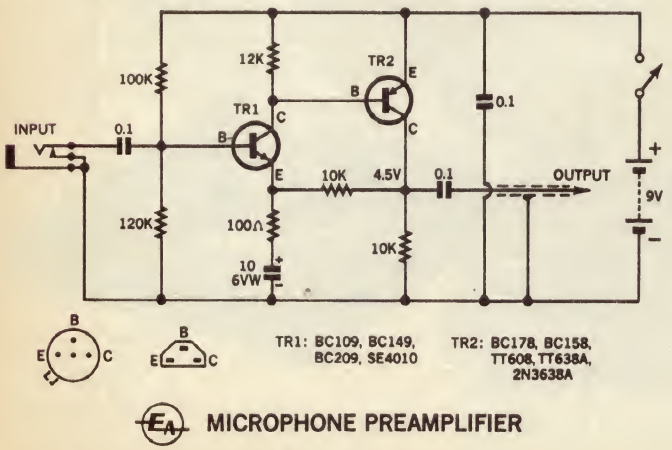
$$R = \frac{(Vcc - 9V) \times 1000}{0.45}$$

Vcc is the supply rail of the amplifier. For example, if the amplifier has a supply rail of 45V, the required resistor value is 82K (closest preferred value). If the amplifier was a valve type with HT rail of 300V, the nearest preferred value resistor is 680K. If two preamplifiers are to be used, the resistor value should be halved.

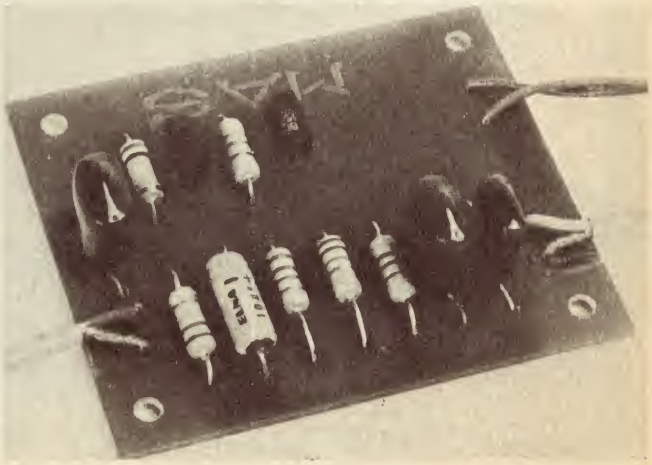
The printed board measures 2½ x 2⅛in and is easily assembled. Lockfit transistors may be used if desired.

PARTS LIST

1 printed board, 2½ x 2⅛in (72/p2)
1 silicon NPN transistor, BC109, BC149, BC209 or SE4010
1 silicon PNP transistor, BC178, BC158, TT608, TT638A, 2N3638A
1 Eveready 216 or equivalent 9V battery
1 SPST switch
1 shorting jack socket
3 0.1uF/100VW metallised polyester capacitors
1 10uF/6VW electrolytic capacitor
RESISTORS
(½ or ¼ watt rating)
1 x 120K, 1 x 100K, 1 x 12K, 2 x 10K, 1 x 100 ohms.



EA MICROPHONE PREAMPLIFIER



Above is the basic circuit and at right is an assembled board.

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SANSUI MODEL SR2050C — FOR AUTOMANUAL OPERATION.
● Belt drive ● 4 pole hysteresis synchronous motor ● Automatic lift and stop which is electrically operated — a detector circuit operates a relay/solenoid system ● Push-button speed controls ● Two speeds ● Cueing control ● Precision built statically balanced tone arm ● Induced magnet cartridge with a frequency response of 20-20,000 Hz. and an output of 5 mV. ● Wow — Less than 0.07% ● Removable dustproof acrylic cover ● Hand finished cabinet of selected walnut ● Recommended list price — $231.

SANSUI MODEL SR4050C — FOR AUTOMANUAL OPERATION.
● Deluxe two speed model ● Belt drive ● 4 pole synchronous motor ● Automatic lift and stop which is electrically operated — a magnetic reed switch and plunger gently lifts the arm and stops the turntable ● Push-button speed control ● Cueing control ● Statically balanced gimbal design tone arm ● Induced magnet cartridge with a frequency response of 20-20,000 Hz. and an output of 5 mV. ● Wow — Less than 0.06% ● Removable dustproof acrylic cover ● Hand finished cabinet of selected walnut ● Recommended list price — $320.

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Progress on Opera House Organ

Installation of the world's largest mechanical-action pipe organ is now well under way at Sydney's already famous Opera House.

Although most of the pipes, the soundboards, the mechanism and the console have yet to be installed, the organ is already beginning to look very impressive. A glittering array of "show" pipes adorn the facade, making it strongly reminiscent of the classical 17th and 18th-century instruments.

The show pipes are of almost pure tin, and have been imported from Holland. They are classically proportioned diapason pipes, and form part of the organ's "32ft Principal" stop. The largest metal pipe in the stop is for EEEE, shown being installed at right. The four notes below this are blown by wooden pipes, which because of their great length have been placed at the rear of the organ.

When complete the Opera House Organ will possess more than 100 stops, including a second 32ft rank. There will be approximately 9,300 pipes, which is about 1,000 more than the mammoth organ in Sydney Town Hall. It is hoped that the organ will be playable when the Opera House is officially opened in 1973, but it may not be fully completed until 1974. Final cost is estimated at over $400,000.

The organ has been designed by Sydney designer and builder Ronald Sharp. Completely self-taught as an organ builder, Mr. Sharp has designed and built 15 pipe organs in the last 13 years, including the instrument at St. Mary's Cathedral in Sydney. General supervision of the installation is by Hall, Todd and Littlemore, the team of Australian architects given the job of completing the Opera House after Joern Utzon resigned in 1966.

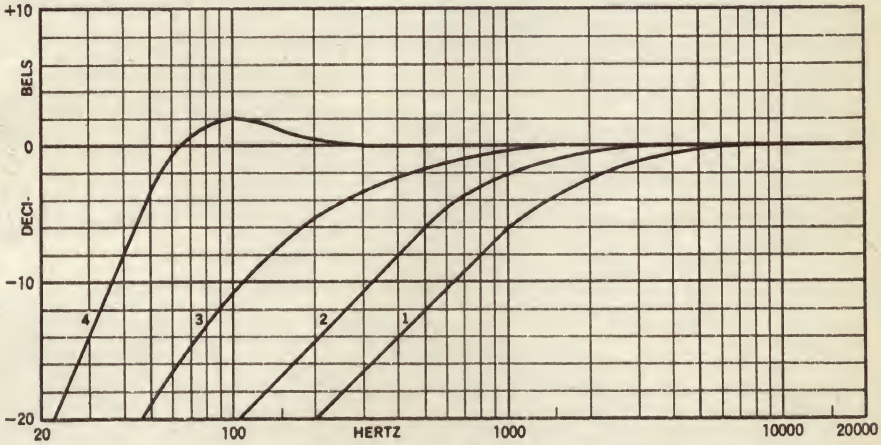
Probably the most interesting feature of the organ is that it will employ direct mechanical or "tracker" action to link the keys of the console with the pallet valves responsible for admitting wind to the pipes. Tracker action offers considerably greater reliability than the pneumatic or electric action systems in favour with organ builders until recently. It also offers the facility for continuous "analog" control of pipe speech from the key, compared with the substantially "digital" or on-off control offered by pneumatic or electric action. For this reason many organists regard it as the "ideal" action. (J.R.)

Designer-builder Ron Sharp supervising the installation of the largest of the front "show" pipes.

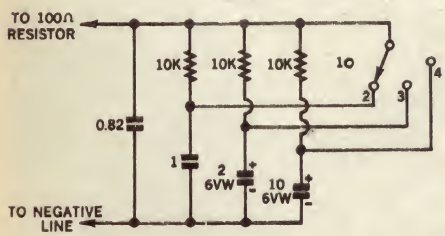
Microphone Preamp — continued

The preamp should be adequately shielded against hum and strong RF fields. If it is a self-contained unit with its own battery, it should be mounted in a metal case which is connected to the negative supply line. If the preamplifier is powered from an amplifier supply rail but is separately housed the DC return path could be via the shield of the output cable, if need be. This means that a figure-8 shielded cable or two wires with a common shield could be used instead of separate cables to the amplifer.

A modification can be made to the feedback loop to modify the bass response of the microphone. One of the problems encountered by "pop" singers is that the apparent bass response of a microphone changes depending on whether it is held very close to the mouth or further away. This has the effect of muddying the singer's voice when he is singing with a close mike. The problem is much reduced if the bass response of the preamplifier is rolled off below about 500Hz and this achieved by decreasing the size of the 10uF capacitor shown on the main circuit diagram.



Bass response curves for each of the feedback capacitor switch positions.



The optional switching circuit gives a choice of four bass response characteristics.

Figure 2 is a switching arrangement of different capacitors which replace the single 10uF capacitor in the feedback loop. In the first position of the switch the feedback capacitor is 0.82uF and this corresponds to the maximum bass roll-off in the frequency response diagram, figure 3. The other three positions of the switch add capacitors in parallel to the 0.82uF to improve the bass response. Each frequency response plot corresponds to one of the switch positions.

Notice the 10K resistors associated with three of the capacitors on the switch bank. These maintain the capacitors at a DC potential equal to that across the 0.82uF capacitor and thus reduce switch clicks.

Two wires should be run from the feedback capacitor position on the board and the capacitors and resistors all mounted on the switch. Take care that the polarity of the electrolytic capacitors is correct.

Using the switch to modify the bass characteristic, the singer can choose the best position for good sound reproduction. With this arrangement, the threnody can be piercingly clear instead of muddy and distorted.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AWA
The "no noise knob"

Primary School where pupils use TV system

Children in a Dutch school are being taught to use closed-circuit television equipment to develop their creative ability by making their own programs. The system is also used for normal subject teaching.

The Dutch Association for the Public Good, founded in 1784 has, among other activities, founded primary and secondary schools and other educational facilities. In one of its schools, at Geldrop, close to Eindhoven, an interesting experiment is being conducted in the use of closed-circuit television.

Mr G. H. de Leeuw, the headmaster, has been accumulating experience, and pioneering new applications of the equipment in the school. One of the most important aspects of the education of children in the Netherlands is teaching what is called "verbal expression". It has been found that allowing children to use television equipment to make their own program rapidly develops the creative ability inherent in almost all children, and awakens their ability to express ideas and handle modern communications equipment.

Mr de Leeuw has become enthusiastic about the results obtained in this way. "We let the children in the fourth, fifth and sixth forms produce a school television current affairs program, and this is good enough to be broadcast fortnightly as a 30-minute program within the school", he said. "In these programs the children have interviewed for television one of the local grocers, a milk man, the Mayor's wife and the Chief Inspector of Police".

In preparing and producing the programs a team is formed, which changes every time, so that every pupil has a chance to help in the production. There are, for example, two newsreaders, an announcer, a program director, two cameramen and a man responsible for sound effects.

The equipment at the disposal of the teams consists of a camera, a video recorder, a film projector and a slide projector. The school is served by six television receivers supplemented by three overhead projectors.

The television studio is set up in the school hall. Recorded and live programs are distributed throughout the school over a cable network.

At Geldrop, very young pupils make their own TV programs

Mr J. R. van der Perk, at the Son school, working with a colleague on the preparation of a video-taped geography lesson.

The Philips equipment was a gift to the school from the parents of pupils when a new wing was opened. Its primary purpose is, of course, as an aid to education.

"Geography and history are now taught with the help of television", said Mr de Leeuw. "Such lessons can contain large extracts from school broadcast television services. For example, programs of the Dutch School Television Service, previously recorded on a video recorder, are used during lessons".

This kind of program, according to the headmaster, has a high acceptance value.

A similar set of equipment is used in another school at Son, near Eindhoven, where Mr J. R. van der Perk has been experimenting with it for about six months. In the case of Son, Mr van der Perk says that he ends each school week with a "theatrical Friday". This is produced by his sixth form in turn and recorded on a video recorder so that the pupils acting in them can see for themselves how they have been performing. Mr van der Perk says that all his pupils enjoy using the equipment enormously and are enthusiastic about the educational programs.

Mr van der Perk's school uses the television equipment for geography and history lessons as well as for their own programs.

One of the more interesting experiments with the equipment was "pupil observation". Mr van der Perk explains that the camera is mounted in the classroom and allowed to remain there until the children get used to its presence. It is then used to observe their behaviour, and a recording made on the video recorder. In this way the teacher can study the results at leisure. This enables the staff to obtain very valuable information about the effectiveness of lessons and the interest levels of pupils. The level of teaching can be measured to a certain degree in this way.

A new and interesting development which has grown out of the use of television in schools is the appearance in school programs of television techniques as a subject itself. This is expected to become increasingly important as more and more television equipment makes its way into school studios.

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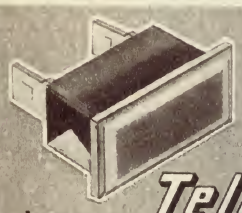

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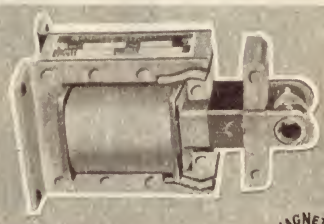

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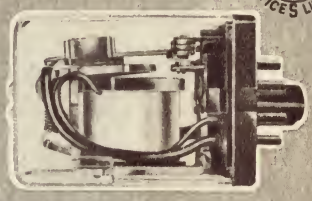

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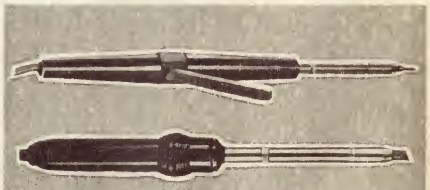

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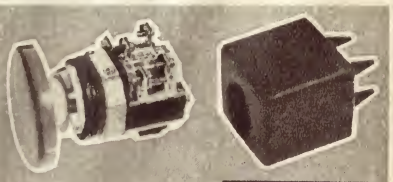

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Photographic breakthrough with laser holography

The double helix revealed

A technique for deblurring photographs by means of laser holography, developed in the USA, has been applied with considerable success to improving the resolution of electron micrographs. Using the device, scientists have produced a picture which clearly shows for the first time the internal helical structure of a virus.

by Professor George W. Stroke

Director of the Electro-Optical Sciences Laboratory, State University of New York, Stony Brook.

It can be very frustrating for a photographer to discover that a hard-earned shot is badly blurred, especially when the photographer was an astronaut taking pictures from orbit. Yet all need not be lost on such occasions. A few years ago I started to develop, with my students, a technique that is capable of turning a bad photograph into a good image in a great number of situations. In particular, we deblurred pictures taken by Lovell and Aldrin from the Gemini 12 satellite. Their hand-held Hasselblad camera was accidentally out of focus during a look at the coast of Arabia. Other cases suitable for our method include photos blurred by motion, atmospheric turbulence and instrumental defects. Furthermore we can improve dramatically the resolution of electron microscopes which have instrumental limitations.

Perhaps the most dramatic deblurring results obtained to date are shown in the figures. They illustrate the application of the holographic image deblurring method which we first described in 1967 under the name of "holographic Fourier-transform image-deblurring method" (Physics Letters, vol 25A, p 89). The holographic image deblurring method requires very considerable photographic care. By means of a new type of "holographic filter" (Physics Letters, vol 33A, p 3) which we developed recently, the holographic image-deblurring arrangement is capable of carrying out the complex image-deblurring computation with a speed and data-capacity unattainable with even the most modern digital electronic computers, in their present state of development.

A blurred photograph may be "deblurred", and a sharpened image extracted from it, because the "blurring" in the original photo did not cause an irretrievable loss of the high-resolution imaging information. An observer may assume that the information is lost when looking at an out-of-focus or motion-blurred photo. But the sharp image actually is "encoded" in a decodable "convolution-integral" form in the blurred photograph.

The decoding operation may be readily carried out by means of the optical analogue computing arrangement shown in figure 1. The principles of optical image deblurring are highly mathematical and their details require considerable development beyond the scope of this introductory presentation. The principles may however be briefly sketched out with the aid of diagrams such as that of figure 1.

In simple terms the process involves creating a holographic image of the blurred photograph, passing this image through a deblurring filter, then restoring the holographic image to a visual image.

The deblurring filter is made from a single point taken from the blurred picture, since this is blurred by the same defects — poor focus, movement, turbulence etc, or combinations of these — as the remainder of the picture.

(The amplitude filter shown in figure 1 would appear to be a hologram of a blurred point. Editor, Electronics Australia.)

The production of the deblurring holographic filter involves as much art and technique as it does theory and mathematical expertise.

In physical terms, the principle of optical image deblurring may be quite readily compared to electrical signal filtering methods, such as those used in high-fidelity sound reproduction equipment. As in sound "frequency equalisation", where the amplitude and phase of distorted frequency-components are restored by suitable networks of resistors, capacitors and inductors, we find that the optical image-deblurring procedure consists of suitable action on the spatial-frequency components in the blurred photograph, by means of the optical deblurring filter.

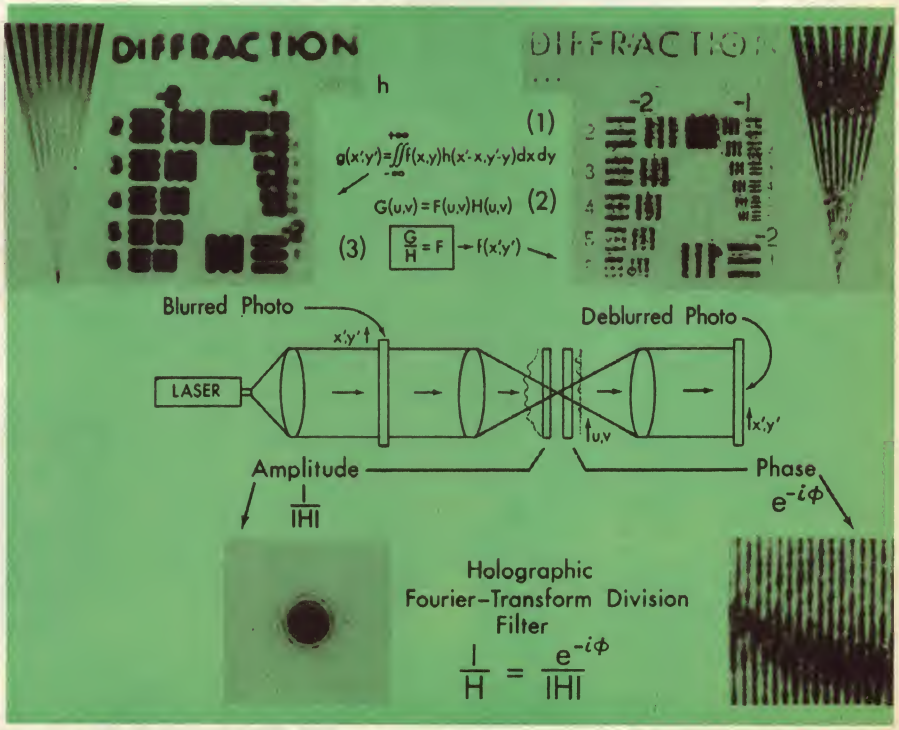

Figure 1. This diagram illustrates the basic principles of the deblurring operation. For explanation, see text.

By arrangement with "New Scientist", London.

Some expensive stereo sets actually sound like this.

And generally it's because of the speakers. No stereo in the world can sound better than the speakers allow it to. A point people all too easily forget. And which in the early fifties worried a Swede called Stig Carlsson.

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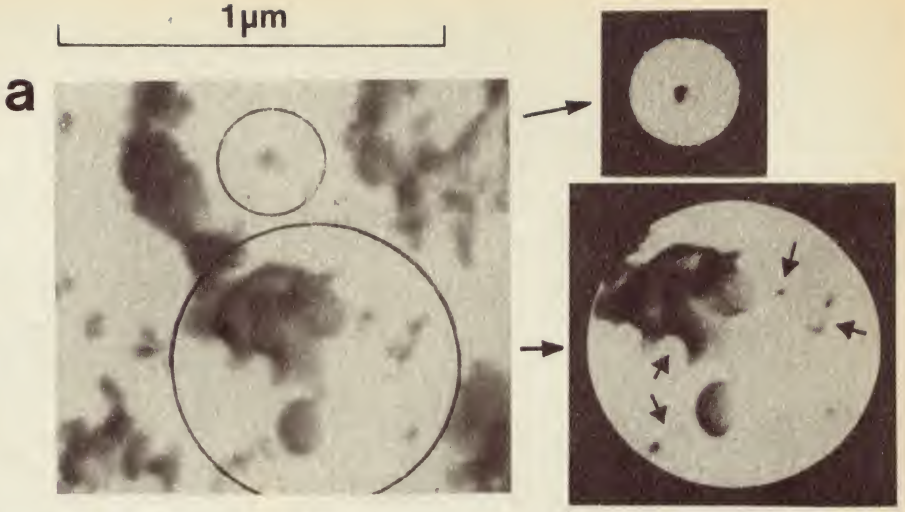
The deblurring operation may be intuitively explained with the aid of figure 1. One of the inserts in the blurred photo illustrates the degradation in the image of a radial test-bar chart, when it is badly out of focus.

In the original test-bar chart, all the radial spokes (bars) in the fan-like chart had the same intensity, either all black or all white, respectively. First of all, we notice that the overall contrast of the spokes in the out-of-focus images of the chart decreases with increasing closeness of the bars: the "closeness" of the bars is generally measured in terms of the number of white or black bars per linear millimetre at right angles to the bars. The number of bars per mm is called the "spatial frequency". We thus notice that the overall contrast in the blurred photo of the radial-bar chart decreases with increasing spatial frequency of the bars.

A closer look at the blurred photograph reveals an even more striking phenomenon. The contrast drops completely to zero somewhere about one third from the top. At that spatial frequency the image of the bars having that frequency is so badly blurred that there is no image at all. However, as we proceed towards still higher frequencies, the contrast gradually improves, and this may well seem to be encouraging. However, if we closely examine the location of the black maxima in that region, compared to the location of the black maxima in the top third of the chart, we notice that the maxima are shifted by half a period (half an interval between two consecutive black bars). This shift is known as a "phase shift" for the bars having spatial frequencies for that domain (say the spatial frequencies for the middle third of the chart in this case). What this shift means, in terms of a more complicated image, is that regions in the original object with spatial frequency components in the shifted range will have their intensity incorrectly represented in the "blurred" photograph. As a result, regions which should be black may be white, and vice versa.

The importance of this remark must be additionally stressed. It is not readily possible to look at an electron micrograph, for example, which was recorded "blurred" because of unsurmountable instrumental imperfections (aberrations) and make definite conclusions from simple inspection. Some regions may be faithful representations of the generally unknown specimen, but other regions may have their intensity completely reversed! Clearly, erroneous interpretations of the specimens would result under these conditions. That this reversal of intensities really happens is illustrated by the letter "A" in the blurred photo of the word "DIFFRACTION' The centre of the letter appears "black" where it should have been white!

The image deblurring results shown here may not be obtained by the several methods of photographic (or electronic) "contrast enhancement", such as high-contrast printing, as one may perhaps be tempted to assume when first exposed to such results. Clearly no "high-contrast printing" alone could conceivably shift the incorrectly located bars back to their correct position (and to equalise the intensity throughout the radial chart). Nor could "high-contrast printing" help in the case of the reversed



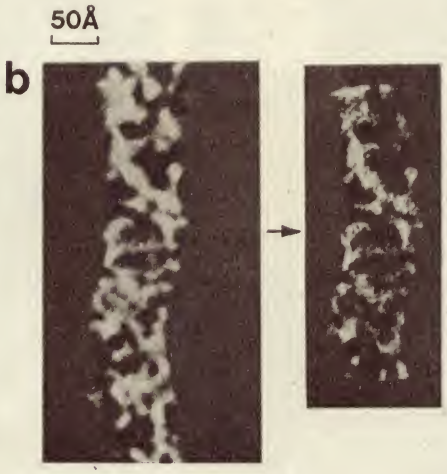


Figure 2. The effect of image sharpening on an image of gold palladium particles (a, above) and the fd virus (b, below). Originals are on the left, the deblurred versions on the right.

contrast in the letter "A": in fact, high-contrast printing would have made the centre of the letter "A" even more "black", compared to the rest, rather than restoring it to white.

These image imperfections, which were previously characteristic of all electron micrographs, clearly resulted in incorrect structure and image interpretation in many cases. Even though this may not be readily apparent from a mere inspection of the electron micrograph of the virus of figure 2 it is characterised by the same inversion of contrasts and shifts in component spatial frequencies as in the blurred photos of figure 1.

The restoration of the intensities in a blurred photograph to their correct contrast and location requires acting on two parameters: the amplitude (i.e. the intensity) and the phase (i.e. the location of the maxima of the different spatial frequency components). The solution to this problem is provided by the holographic Fourier-transform division filter. It is illuminated by a collimated beam of laser light which passes through the blurred transparency. The filter is located in the focal plane of a lens which follows the blurred transparency. It can be shown that when a transparency consisting of a regular bar grating (say one of the spatial frequency regions in the radial bar chart) is illuminated with the collimated beam of laser light, then a similar grating-like image (spectrum) will appear in the "Fourier plane" where the filter is located. In effect, the lenses perform "Fourier transformations" on the images.

What is remarkable is that the spatial frequency of the spectrum in the Fourier plane is inversely proportional to that in the bar chart. In other words, the regions of the

bar chart with coarse spatial frequency (widely spaced bars) will produce a spectrum with very high spatial frequency (closely spaced spectral "lines"), and vice versa. Moreover, no matter where in the "blurred" transparency a given spatial frequency component section is located its spectrum will appear in the same place in the Fourier plane, provided only that the components have the same orientation. If the bar grating is rotated, its spectrum rotates with it. Thus the spectra of all bar components of same spatial frequency and orientation are all superposed in the Fourier plane. It is this fact which permits one to restore all the incorrectly imaged spatial frequency components in the blurred photograph with only one filter in the Fourier plane. It will become clear now also why the filter consists of two components, an amplitude component and a phase component.

The amplitude component, IHI^{-1}, for the case of an out-of-focus photo consists of the ring system shown in figure 1 (it happens to be an Airy disk, with "gaussian" weighting). We can readily imagine that this ring system is formed by rotating a grating-like spectrum about the central axis. We note immediately that the amplitude component of the filter is darkest at the centre (the region corresponding to the lowest spatial frequencies in the out-of-focus test bar chart), and that it becomes increasingly more transparent away from the centre (the regions corresponding to the highest spatial frequencies in the test bar chart). Since the blurred photo of the test bar chart is characterised by a very weak intensity in the high-frequency regions (lower third of chart), compared to the low-frequency regions (upper third of chart), the restoration of correct intensity is performed by the amplitude component of the filter, which greatly enhances the high-frequency components as a result of its great attenuation of the low-frequency components by the dark-ring portion in its central region.

The restoration of the phase (correct location of the frequency components in the bar chart) is equally straighforward. A greatly enlarged section of the phase component, $e^{-i\phi}$, of the filter is shown in figure 1. It is a part of the filter straddling two of the white rings, near the centre of the amplitude component. Close inspection of the phase component of the filter also reveals a grating-like structure; it is in fact the "carrier" grating of the hologram which forms the phase component of the filter. An even closer look reveals, moreover, that the carrier "fringes" in the holographic grating are displaced in one ring by exactly half a grating interval relative to the adjacent one. It may be shown that this half-interval displacement in the filter is exactly the displacement required to compensate for the half-interval displacement of the bars in the central third of the blurred radial test-chart photo. Similar fringe displacement characterises the corresponding phase shifts in the blurred images.

By far the most important results have been obtained within the last few months when we succeeded in holographically increasing the resolution of electron micrographs obtained by the most powerful electron microscopes available. This improved resolution is beyond the limit attained when the microscope is operating under its normal conditions. The results are shown in figure 2. Figure 2a shows on the left the best electron micrograph (magnification 50,000x, resolution = 200 angstroms) that can be obtained with the type of commercial instrument used (the specimen shown consists of gold-palladium particles on collodion film). By using the same arrangement as that represented in figure 1, we extracted from the original micrograph the considerably sharpened images on the right; not only is the resolution increased (by a factor in excess of 3, to 70 angstroms) but the edge definition and contrast are also correspondingly increased — in keeping with theory. The

Figure 3. This sharpened image of another specimen of the fd virus clearly shows a double helix structure.

arrows point to several details which would have been easily subject to incorrect interpretation in the original micrograph.

The reason why the holographic image sharpening method may be used to increase the resolution so considerably in the electron micrographs may not be immediately obvious. What may be shown is that the images (figure 2, left) which result from scanning with a "gaussian"-intensity-profile beam of finite width (200A for figure 2a, and 5A for figure 2b) in the electron microscope may be very closely approximated by images which would have been obtained in the microscope by scanning with an infinitely narrow beam (a physical impossibility), had these images been out of focus (as in figure 1) by an amount which would make the spread-function (blur circle) diameter equal to the diameter of the scanning beam. Accordingly, the image deblurring method and filter may be made to be ideally suited for the sharpening of electron micrographs by the considerable amount shown — much beyond the resolution attainable in the microscope itself.

In collaboration with Professor A. V. Crewe we have recently succeeded in increasing the resolution of the most powerful electron microscope in the world — the one which he recently completed at the University of Chicago. The result is shown in figure 2b. The original micrograph (resolution 5 angstroms, magnification about one million) is a transmission scanning electron microscope photograph of the fd filamentous virus obtained from E. coli. It is, as far as we know, already the most highly resolved electron micrograph of a biological specimen. Even so, it may be shown that this high resolution may just fall short (by a factor of 2) of that needed to reveal faithfully the structure of such viruses, because of the reasons discussed above.

The considerable sharpening achieved by the holographic method is clearly apparent in the photograph on the right, in figure 2b. We estimated that the theoretical limit of resolution, as set by diffraction, was certainly attained. The holographic method compensated for the geometrical aberration of the microscope, which had not heretofor appeared surmountable by known means of construction. Moreover, it can be shown that the signal / noise ratio in the holographically sharpened micrographs is also greater by the same factor (in excess of 2), in comparison to that which would have been obtained had the original micrograph been recordable with a correspondingly finer probe beam.

One of the most exciting results which we have obtained is shown in figure 3. It happens to be a sharpened electron micrograph of another specimen of the same fd virus, recorded under similar conditions as that of figure 2b. It is probably the first photograph of a virus clearly showing a structure resembling the double-helix of the famous DNA molecule. The length of the half period shown is approximately 150 angstroms. Because the virus was probably deformed during preparation, more work is required to confirm its structure. It is most important to note that an increase of resolution by factors of 2 or 3, as demonstrated here, are to be considered as "considerable" indeed, in biological applications of electron microscopy at these very high resolutions.

Utility Amplifier-Supply for the experimenter's bench

Here is a small utility amplifier and power supply unit which would be an ideal project for both the home experimenter and the radio club member. Low in cost, it is easily built, as most of the components are mounted on a small printed wiring board.

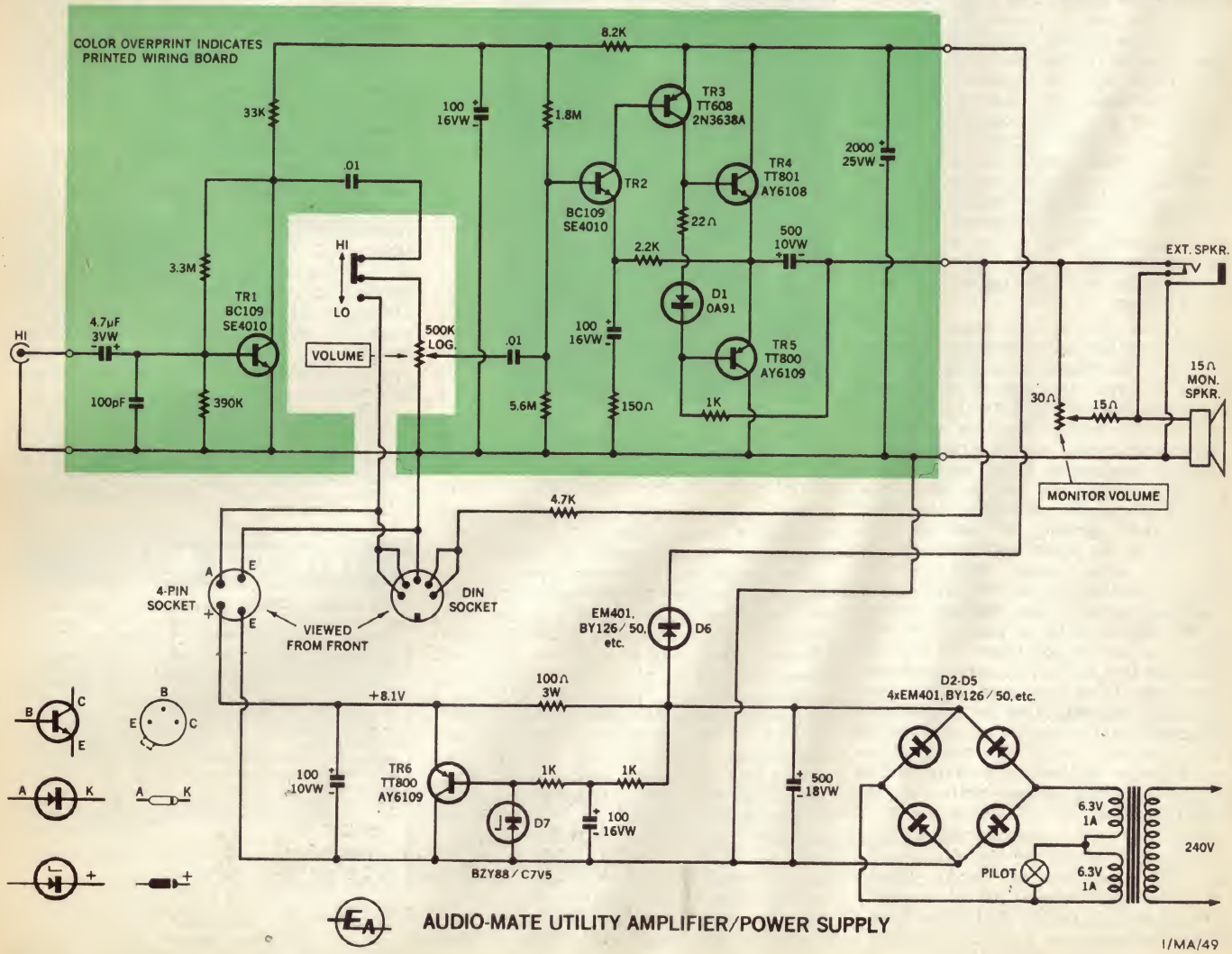
by JAMIESON ROWE

How often have you wanted to try out quickly an interesting new transistor circuit idea, and been frustrated because you didn't have either a convenient power supply or a suitable audio amplifier? If this has ever happened to you, you'll surely agree that two of the most useful things to have on the experimenter's bench are a low voltage DC power supply and a general purpose audio amplifier.

The little unit shown in the photographs and described below has been designed to provide both these useful facilities at low cost. We have dubbed it the "Audio-Mate".

The Audio-Mate comprises a fully solid state general purpose audio amplifier, together with a regulated and filtered DC power supply capable of supplying 8 volts at up to 100 milliamps. The amplifier has a wide frequency response, and includes a microphone preamp which may be switched into circuit when required. An inbuilt

Above is a view of the Audio-Mate complete in its case. Below is the circuit.



AUDIO-MATE UTILITY AMPLIFIER/POWER SUPPLY

I/MA/49

monitor speaker is fitted, but there is also a jack socket to allow the use of an external speaker when desired. In addition there is a 5-pin DIN socket so that both input and output of the amplifier may be connected conveniently to a tape recorder.

The power supply section of the Audio-Mate uses a simple shunt regulator circuit which is inherently protected against damage due to short-circuits. It is therefore well suited for use on the experimental bench, where accidental shorts can often occur. The output is well filtered, and the 100mA current capacity is adequate for the majority of low power receiver, converter, oscillator and audio circuits.

The uses of the Audio-Mate are really only limited by the builder's imagination. The unit would be ideal for the radio experimenter, allowing him to try out an endless variety of simple "front ends" without fuss and with a minimum of delay. The experimenter keen on electronic music and sound effects circuits can also use it to try out ideas quickly and easily.

In association with a high-quality external loudspeaker, it can be used with a gramophone turntable and pickup for record playing. It is also well suited for use with a battery operated tape recorder, whether reel type or cassette, as it can supply the recorder with power while at the same time boosting its audio output. It can be used as a nursery monitor system, and even pressed into service in an emergency as a low power indoor public address system. Fitted with a detector probe, it may be used as a simple signal tracer when servicing radio and television receivers. Radio amateurs can also use it as a modulator for use with low power solid state transmitters.

In short, the Audio-Mate is a very versatile little unit which would be an asset to any experimental bench. It would also be very suitable as a constructional project by youth radio clubs, as it is easily built up at low cost, and provides valuable experience in basic electronic construction.

The amplifier section of the Audio-Mate is very straightforward, using a total of only five transistors. Almost all of the components are mounted on a small printed wiring board, which is the same board as used in the Silicon Transistor Intercom of August 1971.

The main section of the amplifier uses four low cost silicon transistors in a standard direct-coupled transformerless circuit. A BC109 or similar NPN transistor is used as an input voltage amplifier, with a TT608 or similar PNP device following as a driver for the complementary-symmetry output stage using a TT800-TT801 or similar pair. Both DC and AC negative feedback are applied to the amplifier by means of the 2.2K resistor between the output emitters and the emitter of the input stage. The feedback stabilises gain and the DC operating conditions, improves frequency response and reduces noise and distortion.

The basic amplifier has a power output capability of approximately 1.5 watts, which it will deliver into any load between 8 and 16 ohms. It has a voltage gain of 15 times, and thus requires less than 350 millivolts for full output. The frequency response is quite wide, being 3dB down at approximately 40Hz and 150KHz, and distortion is low.

The microphone preamp stage uses a

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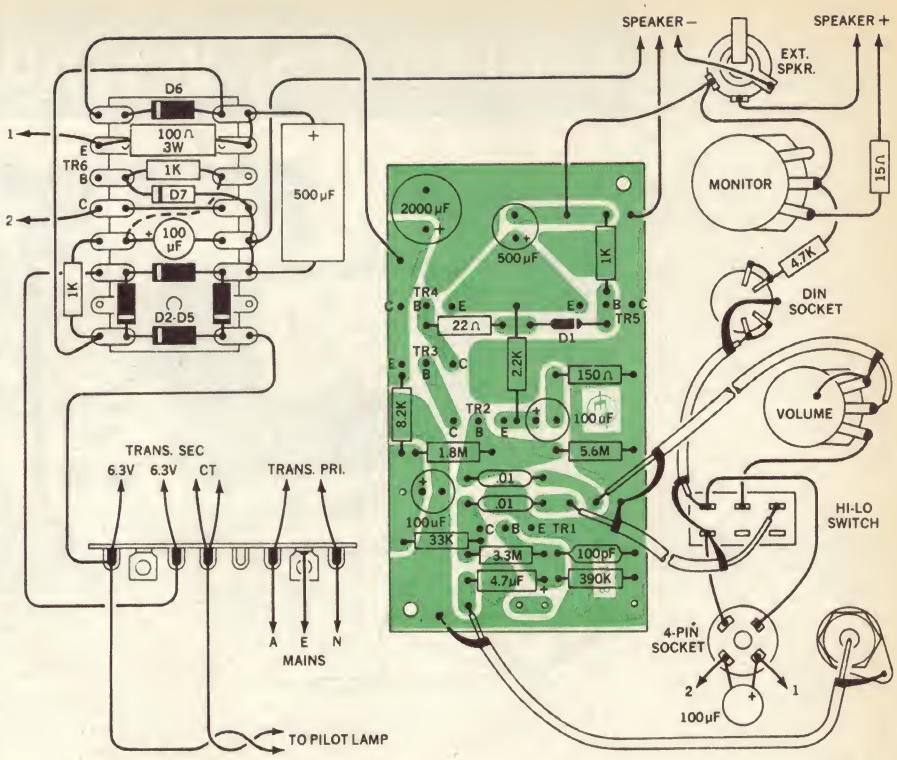
single BC109 or similar low-noise NPN transistor in a standard common emitter configuration, and is mounted on the main amplifier board. The preamp has an input impedance of about 3K, and is usable with most medium to high impedance microphones. The voltage gain depends upon the impedance of the microphone or other signal source, because of the negative feedback introduced by the 3.3M bias resistor between collector and base; it will be more than 100 times for low impedance microphones, but drops as the source impedance rises.

A volume control potentiometer is fitted to the input of the main amplifier section, with a slider switch which connects to top of the pot to either the "LO" input connectors or the output of the preamp (whose input is the "HI" input). Two different LO inputs are provided, with parallel connections. One input is available at the appropriate pins of the 5-pin DIN socket, while the other is via two pins of a miniature 4-pin socket. The other two pins of this socket are used for the output of the 8V power supply, so that the socket provides a convenient way of connecting to experimental receivers and other circuits.

The output of the amplifier is taken through a 4.7K isolating resistor to the 5-pin DIN socket, to provide a recording output, and also to the jack socket provided for an external speaker. The contacts of the jack are connected so that when an external speaker is not used the output of the amplifier is connected directly to the 10-ohm internal speaker. However when an external speaker is plugged in the direct connection to the internal speaker is broken, and the speaker receives power instead via a series 15-ohm fixed resistor and a 30-ohm variable. This allows the internal speaker to be used for monitoring, without it absorbing more than a minor proportion of the amplifier's modest output.

Power for the complete Audio-Mate is supplied by a simple stepdown transformer and bridge rectifier circuit using four 1 amp silicon diodes. A 500uF capacitor is used as the main rectifier reservoir, but a separate 2000uF capacitor is used as a separate reservoir for the amplifier section. The 2000uF capacitor is charged via a fifth diode which tends to isolate the two capacitors, allowing the class-B output stage of the amplifier to draw quite high transient currents (supplied by the 2000uF capacitor) without significantly disturbing the output voltage of the main supply. This simplifies the design of the 8V regulator circuit.



The wiring diagram for the Audio-Mate, showing the placement of all components mounted on the wiring board and miniature resistor panel.

The regulator circuit itself is very straightforward, and uses a single TT800 or similar medium power PNP transistor in a shunt circuit. The transistor is in fact used as an "upside down" emitter follower, with an R-C filter circuit and a zener diode used to stabilise the base voltage. As the transistor is connected across the output of the supply, it is not embarrassed in the least by a short-circuit across the output terminals. In fact it dissipates most power when the supply is unloaded, and progressively less power as loading is applied; with a short circuit, it merely cuts off.

As the photographs show, the Audio-Mate is constructed in a standard small instrument case. The case measures 7½in x 5in x 4in (19cm x 13.7cm x 10.2cm), and has a wrap-around front panel.

Most of the wiring is mounted within the case itself, with only the monitor speaker, controls and input-output connectors mounted on the front panel. The power transformer is mounted on one side of the case, near the rear, with its leads terminated on a miniature 8-lug tagstrip immediately in front. The small printed board for the amplifier is mounted on the bottom of the case, with the power supply wiring mounted above it on the case rear, supported by an 8-lug section of miniature resistor panel.

The wiring and assembly of the unit should present few problems, even for the beginner. The Audio-Mate is a very straightforward device, and its wiring is not

LIST OF PARTS

1 Instrument Case, 7½in x 5in x 4in, with wrap-around panel.
1 Step-down transformer, 240V to 6.3V plus 6.3V or 12.6V CT at 1A.
1 Printed wiring board, 71/a8.
1 3-inch loudspeaker, 15 ohms.
1 Slider switch, SPDT.
1 5-pin DIN socket.
1 Miniature 4-pin socket.
1 Jack socket with N/C contact.
1 Insulated microphone socket.
1 Miniature pilot bezel, 6V 50mA.

SEMICONDUCTORS
5 EM401, BY126 or similar diodes.
1 OA91 or similar diode.
1 BZY88/C7V5 or similar zener.
2 BC109, SE4010 or similar.
1 TT608, 2N3638A or similar.
2 TT800, AY6109 or similar.
1 TT801, AY6108 or similar.

CAPACITORS
1 100pF polystyrene.
2 .01uF 100V polyester.
1 4.7uF 3VW electrolytic.
2 100uF 10VW electrolytic.
2 100uF 16VW electrolytic.
2 500uF 18VW electrolytic.
1 2000uF 25VW electrolytic.

RESISTORS
1 15ohms ½watt
1 22ohms ½watt.
1 100ohms 3watt.
1 150ohms ½watt.
3 1K ½watt.
1 2.2K ½watt.
1 4.7K ½watt.
1 8.2K ½watt.
1 33K ½watt.
1 390K ½watt.
1 1.8M ½watt.
1 3.3M ½watt.
1 5.6M ½watt
1 30ohm wirewound pot.
1 500K log pot.

MISCELLANEOUS
Mains cord and 3-pin plug; handle and rubber feet for case; miniature 8-lug tagstrip, 8-lug section of miniature resistor panel; 4in x 4in square of expanded aluminium or similar material for speaker grille; 2 knobs for controls; connecting wire, screws, nuts, clamps for mains cord, solder, etc.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used, providing they are physically compatible. Components with lower rating may be used in some cases, providing the ratings are not exceeded.

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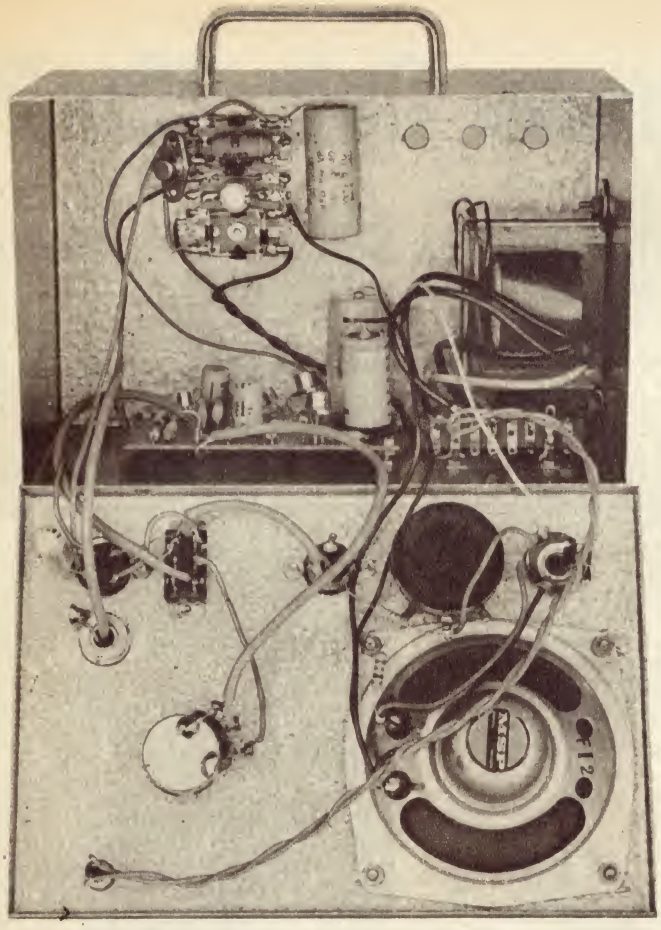


A view inside the Audio-Mate case, with the rear of the front panel also visible. Note the power supply wiring mounted on the rear of the case, and the transformer on the right-hand end.

critical. In any case we have prepared a complete wiring diagram to guide the constructor and minimise any possible problems.

However, there are a few points to bear in mind when assembling a piece of equipment of this type. One is that the mains cord should be brought into the case via a carefully de-burred hole in the rear, the hole being fitted with a suitable rubber grommet. Upon entry the cord should also be securely anchored using a "C" clamp, to prevent strain and possible breakage of the connections. The earth wire should be connected reliably to the case of the unit, with the wire terminations arranged so that if the cord clamp should loosen, the earth connection would be the last to break.

The amplifier printed board is attached to the bottom of the case via two ⅛in Whitworth screws, with additional nuts used to space the board approximately ¼in above the metal for clearance. The board is quite small and light, and two screws are adequate to secure it in this way.

The microphone socket should be insulated from the front panel, and its "earthy" side taken to the earthed copper of the wiring board via the shield braid of the wire between the two. Similarly care should be taken to wire the shield braids of the other shielded wires so that they do not form continuous earth loops. These precautions will ensure that the completed amplifier has a negligible hum level.

When the Audio-Mate is completed, it should be possible to switch it on and obtain full operation immediately. There are no adjustments to be made, although the cautious constructor may wish to make a couple of quick measurements to make sure that everything is in order.

Only three measurements need be made, and if these check out satisfactorily, all should be well. The first is to measure the voltage at the junction of the two output transistor emitters in the amplifier, with reference to earth. Using a 20,000 ohm per volt multimeter or similar this point should measure between 8 and 10 volts.

Next the quiescent current of the amplifier as a whole could be measured, by breaking the positive lead running from the printed board to the power supply diode, and inserting a multimeter set to a 100mA or higher current range. The current should read from 40 to 60 milliamps.

If the current is much lower than 40 milliamps, the amplifier may produce cross-over distortion, while if the current is significantly greater than 60mA (say 80mA or more), it may exhibit a tendency to thermal instability and "runaway". If necessary the value of the small resistor (at present 22 ohms) in series with the OA91 biasing diode may be altered to bring the current within the correct range. Increasing the value of the resistor will increase the current, and vice-versa.

A final check would be to measure the output voltage of the power supply regulator. This should be close to 8 volts. If it does not approximate this figure, but instead is around 1 volt, the most likely cause is that you have wired the zener diode in circuit with reversed polarity!

LED Indicator Draws Only 20mW

One of the most significant developments in solid state technology in recent years has been the evolution of light emitting diodes and displays. This article discusses their principle of operation, mentions various applications and describes a very low current drain indicator lamp circuit for battery operated equipment.

by LEO SIMPSON

Until recently, only two common light sources were available for application in electronic circuitry: the incandescent lamp and the neon lamp. One generates light by raising the temperature of its metal filament to incandescence, and the other by ionising a gas mixture containing neon. The first process is inefficient as it requires considerable power and the second requires relatively high voltages to ionise the gas.

But now a third light source is available which is not wasteful of power and does not require high voltages to drive it. It is the light-emitting diode or LED.

A light-emitting diode, also known as solid-state lamp, is a PN junction diode which emits light when biased in the forward direction. The light emitted can be visible or infra-red. Semiconductor light sources are now available in a wide range of wavelengths, extending from the near ultra-violet region of the electromagnetic spectrum to the far infra-red region.

Light emitting diodes produce light by a phenomenon known as PN junction luminescence. When a PN junction is forward biased, electrons move towards the P-type material from the N-type material, and holes move from the P-type material towards the N-type material. In the region of the junction, recombination occurs, i.e., electrons neutralise holes. When this occurs, energy is released in the form of heat and light.

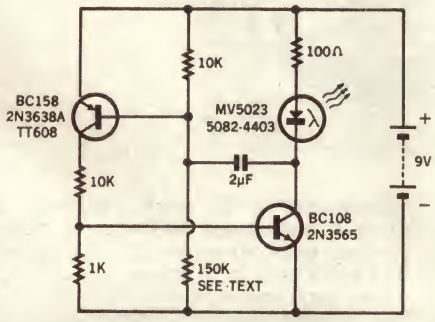
From this general statement, it may be appreciated that light is emitted from the junctions of conventional diodes, but the amount of light is small compared to the heat produced and is not evident since the silicon (or germanium) semiconductor material is not transparent. Gallium arsenide and Gallium phosphide are the materials used for light-emitting diodes.

There are several inherent advantages of light-emitting diodes over conventional lamps. Since an LED has no filament, there is no thermal inertia, so it has very fast response times — typically to 10MHz. Again, because it has no fragile filament and is merely a semiconductor chip mounted in a solid encapsulation, it has very long life and is mechanically rugged leading to much improved reliability. In many cases where an "infinite life" light source or indicator is required, an LED comes closest to fitting the specification. Lifetimes of tens of thousands of hours are possible.

LEDs have low impedance and are compatible with low voltage power supplies and semiconductor circuitry. Their forward bias characteristics are very similar to the silicon diodes but their reverse voltage breakdown characteristic is very much lower — in the order of a few volts.

Other advantageous characteristics of LEDs are: Nearly monochromatic light output; miniature size; freedom from microphony and low power consumtpion.

The stimulus for this article came when Hawker Siddeley Electronics Ltd recently released a range of Monsanto light emitting diodes and seven-segment numeric displays onto the Australian market. While there are dozens of applications for LEDs, mostly in combination with phototransistors, in digital electronics, industrial control and in the communications field, such circuitry is rather esoteric as far as the average hobbyist is concerned.



This flashing indicator circuit draws only 2mA but has high visibility, and is ideal for battery-operated equipment where other indicators cannot be used. The 2uF capacitor must be a low-leakage polyester or tantalum dielectric type.

With these facts in mind, we cast about for a simple circuit which could take advantage of the properties of the LED but would utilise one of the cheaper units in the range. The more powerful LEDs are quite expensive at this stage, ruling the possibility of a light-beam communicator.

As it happened, the circuit we finally decided upon for presentation in this article is the ideal solution to a problem which confronted us some time ago. When developing the Solid-state Volt-Ohm Meter featured in the December 1968 issue of "Electronics Australia" we desired a low consumption pilot light which would enable the user to conserve the batteries by switching the meter off when not required. At the time, there appeared to be no simple solution.

The circuit featured here is ideal for this and any other application where a low drain pilot light is required for use in battery operated equipment. It runs from a nine-volt battery and has an average current drain of only 2 milliamps or less. It has high visibility since it pulses the light-emitting diode at a rate of approximately 10 pps. This takes advantage of the fact that LEDs give higher light output under pulse conditions, and also that the eye is more sensitive to flashing light.

Using a silicon NPN transistor and a silicon PNP transistor, the circuit is an unusual form of multivibrator which has a single RC time-constant. It is unusual in that instead of the two transistors alternately switching into the conducting or blocking state as they do in a conventional cross-coupled multivibrator, both transistors are either conducting or blocking at the same time.

When power is initially applied to the circuit, the 2uF capacitor is slowly charged via the 150K resistor so that its LED end becomes positive. At some point in the charge curve, the PNP transistor becomes forward biased so that it turns on and forward biases the NPN transistor into conduction. Since the 2uF capacitor is connected between the base and collector of these two transistors a regenerative action takes place so that the 2uF is very rapidly charged in the opposite direction.

This rapid charging action of the 2uF capacitor also allows the NPN transistor to apply a brief pulse of current to the light-emitting diode so that it flashes. Once the capacitor is fully charged the voltage across the 150K resistor is almost equal to the supply voltage so that the PNP transistor is biased "off". This switches off the NPN transistor so that the charging cycle via the LED and 150K resistor, recommences and repeats the whole sequence, ad infinitum.

The LED used is the Monsanto MV5023. This is supplied with a clip-in bezel surround for panel mounting and is an economy device. An alternative to this device is the Hewlett-Packard 5082-4403 which is slightly more efficient as it has a better lens.

Apart from use as a power indicator in battery operated equipment such as test equipment and tape recorders, the circuit could also be used as an end-of-life battery indicator, although its sensitivity to voltage will depend mainly on the beta of the transistors. A similar circuit function could be performed by a relaxation oscillator based on a unijunction transistor but we opted for the economy of the bipolar transistor circuit.

Two components in the circuit are critical. The 2uF capacitor must be a low leakage type such as polyester or metallised polyester. Voltage rating is unimportant. The 150K resistor may have to be adjusted to obtain correct operation. If it is too low the circuit will not oscillate and the LED will not light. If the 150K resistor is too high, both transistors will tend to remain conducting and the LED will be lit continuously.

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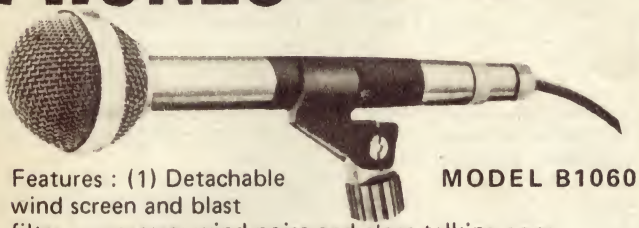

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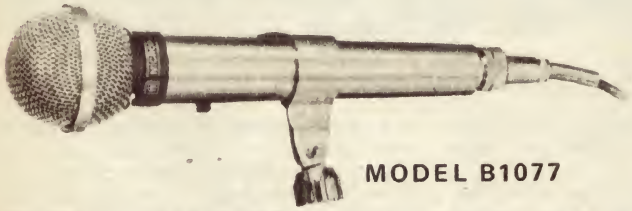

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The Tucker Tin Mark 2*

An SSB Transmitter of simple design — Part 2

In this second article describing his easily-constructed solid state SSB transmitter, the author discusses the remaining circuit sections and such constructional matters as home etching of the printed wiring boards. If your interest was aroused by the first article, this one should start you reaching for the soldering iron.

by FRED JOHNSON, ZL2AMJ

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Central Institute of Technology, Petone, New Zealand

The remaining printed wiring board to be described is the VFO-mixer board. As shown in the block diagram given in figure 1 last month, this module accepts the 9.0MHz SSB signal from the balanced modulator board (leads G and H) and converts it to some frequency in the range 3.5 — 3.9MHz. The 80 metre signal emerges from lead K.

Figure 8 shows the detailed circuit. Q7 is the variable-frequency oscillator. This is a conventional Clapp circuit, using a field-effect transistor. It tunes 5.0 to 5.5 MHz. The components C28 and L6 are adjusted during setting-up for this frequency coverage. The output from the oscillator is taken via C32 to the base of Q8. This is an emitter-follower stage, its purpose being to isolate the VFO from the mixer.

Q9 is the mixer. This has two inputs. R24 is an emitter load which is common to both Q8 and Q9. The VFO signal is therefore injected into the emitter of Q9. The 9 MHz SSB signal is fed to the base of Q9 via L8 and its associated tuning capacitors C37 and C38.

The output from Q9 is taken from the collector. The output frequency is somewhere between 9.0 minus 5.0 MHz (i.e., 4.0 MHz) and 9.0 minus 5.5 MHz (i.e., 3.5 MHz), depending upon the actual VFO frequency setting. The collector tuned circuit must therefore be arranged to tune 3.5 to 3.8 MHz (the 80 metre band). I have stated that the VFO tunes 5.0 to 5.5 MHz. By changing L7 and C35 to another value it is possible to take an output between 9.0 plus 5.0 MHz (i.e., 14 MHz) and 9.0 plus 5.5 MHz (i.e., 14.5 MHz) from this point. The 20 metre band extends from 14.0 to 14.35 MHz so both 80 and 20 metre outputs are possible from Q9 with this 5.0 to 5.5 MHz VFO.

The slug in L7 is the "mixer tune" control and is made separately adjustable, as the "mixer peak" control, but more of this later when the construction of the rig is discussed.

The output to the Power Amplifier (PA) grid is taken from the collector of Q9. A signal from the anode of the PA stage is fed back to the other end of L7 (lead N). This is for neutralising the PA stage against self-oscillation, and will also be discussed later. Lead N was not shown on the block diagram of figure 1.

The action of D5 in the emitters of Q8 and Q9 will be mentioned later.

The mixer and VFO board layout is given in figure 9. Construction is the same as for the previous boards. Capacitor C36 is earthed to the chassis at the same point where R27 (PA valve grid leak) and C43 (cathode decoupling capacitor) are earthed.

The power amplifier stage uses the transmitter's only valve. The circuit diagram for this stage is shown in figure 10. Its function is to accept the signal from the output of the mixer Q9 and amplify it before passing it to the antenna.

The circuitry for this stage is wired using tagstrips where required. As shown in figure 10, some of the wiring is below the chassis and some above. Note that the +300 HT does not appear above chassis—ie. C42 is kept below chassis.

A shield is mounted across the valve socket and is soldered to the chassis on each side of the socket, and to the centre spigot of the socket itself. This separates pins 1, 2, 3 and 9 from pins 4, 5, 6, 7 and 8. Figure 11 gives the construction details.

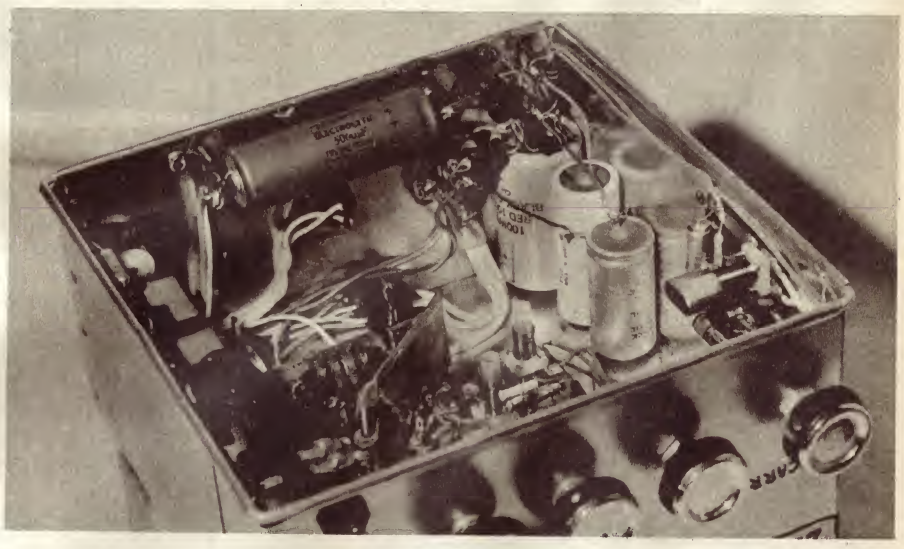
The test point in the cathode of the valve enables the cathode-current to be measured easily (described later). The stage uses a type 12BY7 valve and delivers about 4 watts Peak Envelope Power (PEP) output into a 50 or 75 ohm load.

The voltage across the load is metered by a simple RF detector circuit D6 and M, with their associated components. The meter is used during alignment and during subsequent tuning-up activities.

The construction of the PA stage is quite straightforward and will be treated later. It could be changed to operate on the 20 metre volt band by changing L10, but this has not been tried. The Tucker Tin Mk. II is presented as an 80 metre rig but constructors are welcome to try it on 20 if they wish. It is suggested that you get it going on 80 before trying 20!

The output from this amplifier is capable of driving a subsequent "high power" linear amplifier to full amateur legal ratings. Such an amplifier, built on a matching chassis and panel, could be produced by you to your design quite easily. This is recommended as a later project.

The neutralising capacitor Cn consists of three turns of hook-up wire twisted tight around the lead to the RF choke RFC6. C47 and L11 form a 5.5 MHz VFO trap to remove



A view of the underside of the chassis, seen from the front

* This article is reprinted from the August 1971 issue of "Break-In", the official journal of the New Zealand Association of Radio Transmitters Inc., by arrangement.

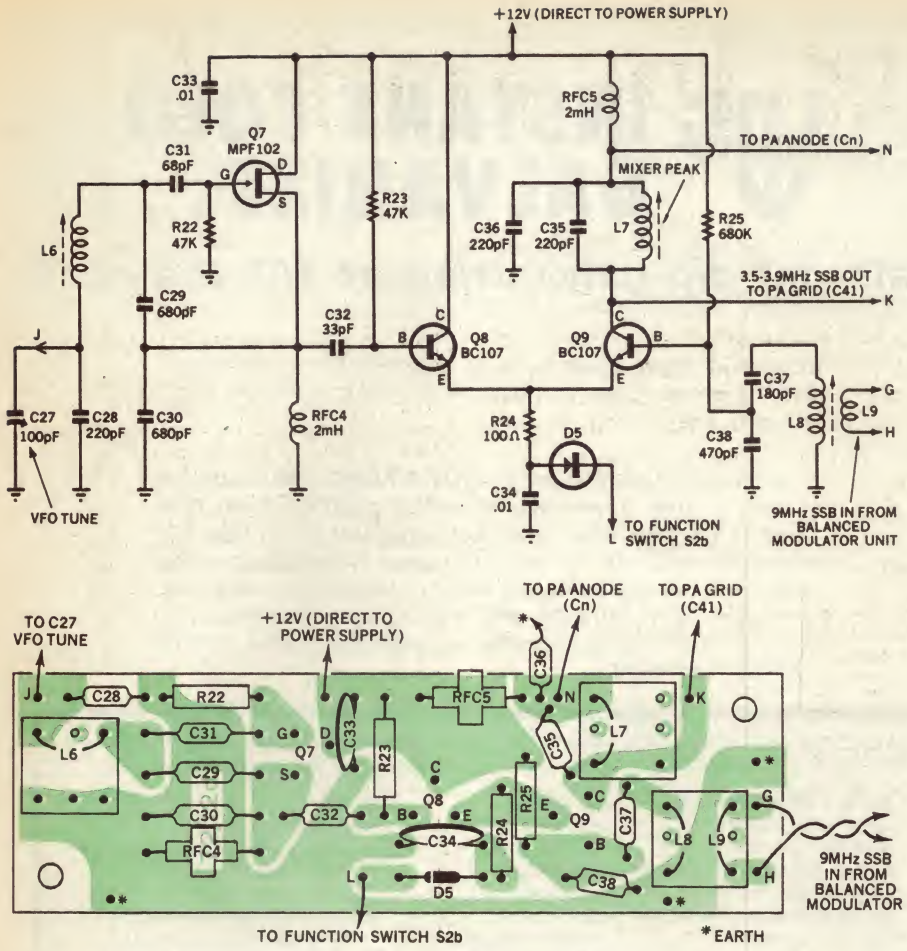


Figure 8 (top): The circuit of the VFO and mixer wiring board.

Figure 9 (above): The board pattern and component layout.

any direct VFO signal from the output. Details of adjustment are given later.

The power supply uses a conventional full-wave rectifier for the +300 volt supply and a voltage-doubler for the +12 volt supply. Fig. 12 shows the circuitry. This too is wired using tag-strips where necessary. Layout and other constructional detail is not critical.

The transformer used is an inexpensive type ideal for the task. It has two secondary windings, one is 250 volt aside at 42mA and the other is 6.3 volts at 2.3 Amps. Diodes D7 and D8 should be 1000 volt PIV (or greater) types rated at 500 mA or 1 Amp. Diodes D9 and D10 should be 50 volt PIV (or greater) types rated at 500 mA or 1 Amp. Because of the negligible price differences between these ratings, it is suggested that all diodes D7 to D10 inclusive could well be 1000 volt 1 amp types.

A mains on / off switch has not been fitted to the original rig. This could however be easily provided by using a potentiometer with a switch as the microphone gain control. The switch section should be placed in series with the mains active lead.

Fig 13 shows the connections between the various boards. The leads are lettered to permit cross-referencing with the circuit diagrams for each individual board. Note that the power supply and PA stage are not shown on this diagram. It will be noticed that many of the front panel components below chassis appear on this diagram — the microphone and key jacks, the audio gain control, sideband switch S1 and the function switch S2.

S1 is simply a change-over switch that swaps over the two audio leads between the audio board and the balanced modulator board. A double-pole changeover toggle switch could have been used. here.

S2 performs several functions. One pole (S2C) is completely isolated from the entire Tucker Tin Mk. II circuitry. It can be used to control the receiver to give send / receive operation of the complete station. Two wires are taken from S2C to the receiver. Possible methods for receiver connection will be mentioned later.

S2A applies the +12 volt supply to the audio preamplifier when SSB operation is required. This +12 volts is removed from the audio preamplifier when tune-up or netting functions are being carried out. This prevents noises inside the shack from modulating the rig. When "netting", +12 volts is applied via R31 to the balanced modulator to cause unbalance and hence a small radiated carrier for netting to the local receiver. The value of R31 is selected to produce a signal of sufficient output for the netting action. R32 creates a larger unbalance so that a carrier signal of much larger amplitude is radiated for tuning-up (this same signal is turned on and off by the CW key when CW operation is desired).

S2B controls the transmitter. The transmitter radiates a signal in SSB, net and tune positions, and is rendered inactive in the receive position (but all voltages are still applied). Both the VFO and 9MHz crystal oscillator run continuously on both transmit and receive. S2B is in series with the cathode of the 12BY7 so that this amplifier is rendered inactive when on receive. This eliminates a possible noise-radiation problem that was reported by several users of the original "Tucker Tin." S2B also switches off the mixer Q9 and the isolator Q8 by breaking their common emitter to earth lead. Because of the common DC connection between the cathode of the 12BY7 and the emitters of Q8 and Q9 when S2B is in the receive position, the voltages across the internal junctions of Q8 and Q9 can rise to high levels and cause damage to these two transistors. To prevent this, D5 (on the VFO and mixer board — figure 8) has been included to block this DC feedback voltage. D5 can be any diode with 50 volt PIV (or greater) and 100mA (or greater) rating. I suggest that it be the same type as diodes D7 to D10 (as used in the power supply) to simplify the ordering of parts.

A jack for the CW key enables the transmitter to be turned on and off when the key is operated. When the key is removed, the closed-circuit contacts operate to permit S2B to operate the transmitter for phone operation. When the key is plugged in the key must be held down to permit both netting and tuning — for CW the switch is left in the "tune" position.

All resistors shown on all diagrams are quarter-watt types unless otherwise stated. Half or one watt types are acceptable but may be bulky and difficult to mount in some positions. Similarly, all capacitors can be 12 volt working types unless stated otherwise. A complete list of all the components necessary was given in the first of these articles.

The transistor types quoted are the ones I used, but there are thousands of possible substitutes for each type. The connections for the specified types are shown in the small diagram, but I leave it to you to sort out your own substitution problem! Some component values may have to be changed when other transistor types are used (e.g. R7, R10, R23 and perhaps R25). These values may also have to be changed due to the spread of transistor parameters between individual devices of the same type. I used BC107B's but there is no reason why BC107A's or BC107C's should not work as effectively.

The layout diagrams given for each of the printed wiring boards differ a little from the prototype boards shown in the photographs. This is a direct result of developments during the production of the prototype. The holes visible on the rear apron of the chassis are likewise evidence of the power supply evolution!

The layout for each of the circuit boards has been given already and the problem now is to evolve a simple means for converting these into hardware. The following method is only one of many possible methods but is suggested to those who have not previously played with printed-circuits. Each step will be numbered so that some logical sequence can be followed. You will be surprised how easy they are to make.

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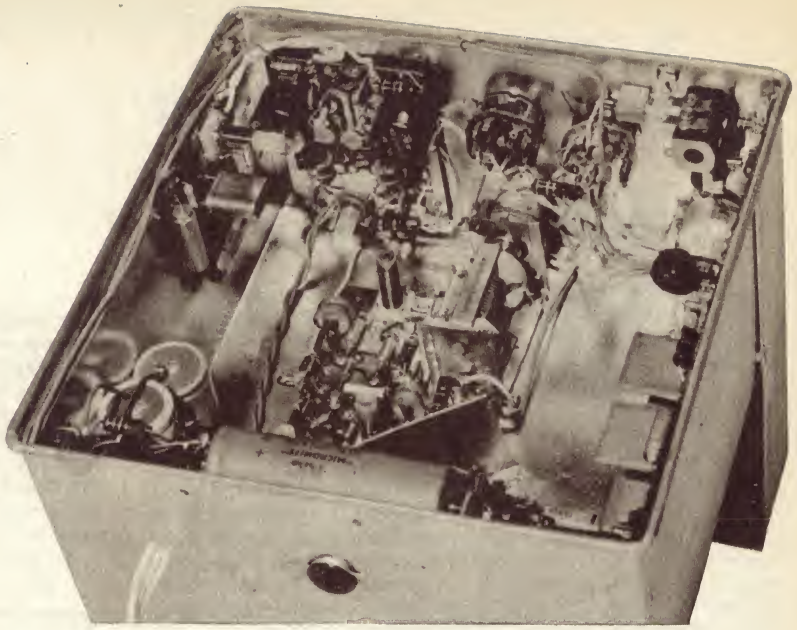
At right is another view of the underside of the chassis, as seen from the rear.



board stock and cut to the size quoted for each board. Either the "sharp hacksaw and cut" or the "scriber with rule then break" method can be used. File all edges clean and square.

2. Polish the copper surface clean, using steel wool or a kitchen abrasive cleaner. Keep your fingers off the freshly polished copper — handle it by the edges.
3. Place the board behind the layout diagram, copper side up. Use carbon paper and a ball point pen and trace the shaded area outlines on to the copper (i.e. ignore the components). The shaded areas represent the conducting areas of copper that are to be retained. Use new carbon paper.
4. You again have a choice here. You can use either a marker pen with ink that is not soluble in water, nail polish, or paint lacquer. The aim is to paint over THE COPPER AREAS TO BE RETAINED. All the areas to be retained must be covered, leaving the unwanted copper areas exposed. This work must be done carefully and with clean "edges" to ensure a craftsman-like result. Let the boards dry until this "resist" is thoroughly dry.
5. The exposed copper areas are now to be etched away. Ferric chloride (obtainable from chemical suppliers) is perhaps the best etchant to use. Use a plastic or glass dish, big enough to take the largest board. Fill with hot water from the kitchen tap. Sufficient liquid is required to cover the board. Add the ferric chloride, three or four heaped teaspoonfuls to each cup of water. Use a plastic spoon as a stirrer. Ensure that all the powder and lumps dissolve.
6. Insert the board, copper side up, making sure that it is completely immersed. Frequent agitation is desirable. The etching can take any time from 10 minutes to 2 hours depending upon the temperature and strength of the solution and the amount of copper to be removed. Inspect it frequently to see progress.
7. When all traces of exposed copper have disappeared, remove the board, wash in cold running water, and dry thoroughly.
8. Using methylated spirits or some other solvent, remove the resist to expose the copper conducting areas.
9. Dry and repolish if necessary.

The board should now show areas of shiny copper, exactly the same as the layout diagram. All boards are treated the same way, and can be made singly or together as you wish.

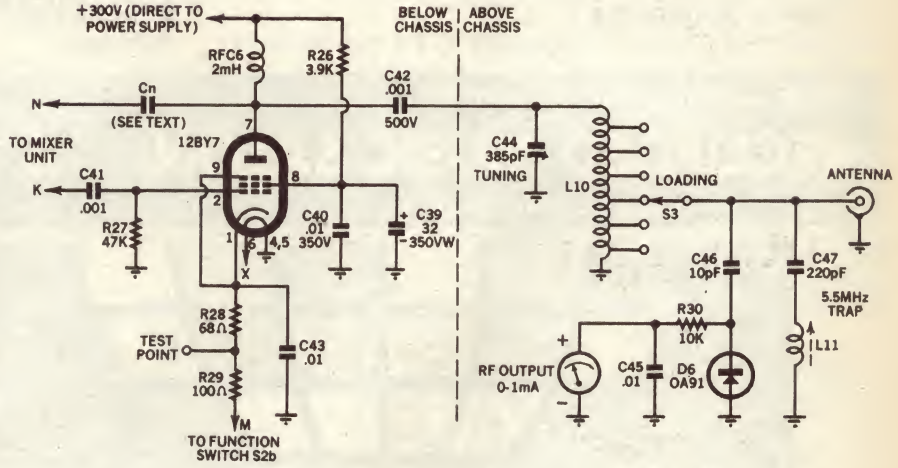


Figure 10: The circuit of the PA stage, which uses the sole valve employed in the transmitter. RF output is 4 watts PEP.

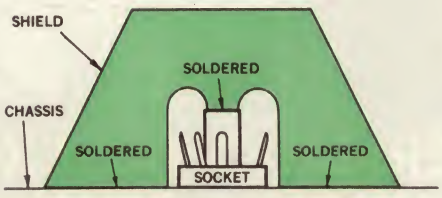


Figure 11: The construction of the shield fitted to the PA valve socket.

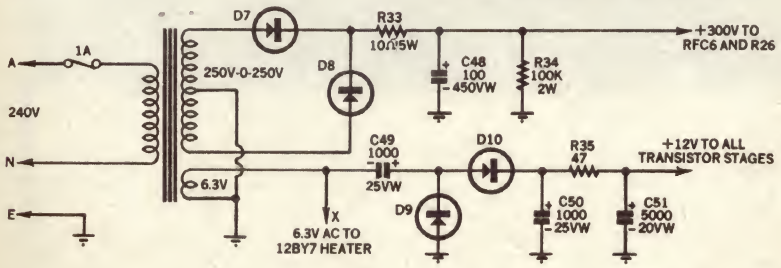


Figure 12: The circuit of the power supply used in the transmitter. For simplicity all diodes may be 1000V 1A devices if desired.

Some practice with some scraps of printed circuit board is recommended before you try the actual boards themselves!

Printed wiring boards usually have lots of holes so that the component leads can feed through the holes to the copper side where the leads are then soldered to the copper. This form of construction has all the components on one side of the board and the copper on the other side and requires the board to be mounted on spacers to keep the copper side away from the chassis. Considerable simplification is possible by soldering the components direct on to the copper side of the board. This eliminates the hole-drilling task. It also simplifies construction because you do not have to keep turning the board over all the time to check connections! The board can also be mounted flat on the chassis thus avoiding spacers (see figure 14).

This form of construction has been adopted in the "Tucker Tin Mk. II" and really makes wiring up very straightforward. The components are soldered on to each board where shown on the layout

diagrams. Each board can be checked against the layout diagram when completed. Beware of short-circuits. Make sure that each component makes contact only where shown (unless the component is insulated). Capacitors, resistors, coils, diodes, transistors, chokes, all are wired direct on to the board. Even the connecting wires to other boards and switches (etc.) are soldered direct on to the copper where shown.

Use a 25 watt soldering iron, and a good quality multicore solder.

The photographs show the general layout of the chassis and the positioning of the boards. The basic chassis is a cake tin 8 inches by 8 inches by 4 inches deep. The front panel is another cake tin, 8 inches by 8 inches by 2 inches deep. These two items are obtainable from chain stores. It is recommended that these tins be used as chassis and panel because they are very easily soldered. The front panel itself is soldered to the chassis. Even the valve socket, tag strips, and the print-boards themselves are soldered into place. This saves a lot of drilling and messing about with nuts and bolts that would be necessary if any other type of chassis was used. In fact, nuts and bolts are only required to

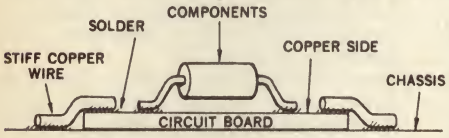


Figure 14: Component mounting and board mounting may be performed in this way.

mount the power transformer, meter, final tuning capacitor and coil, and are not required for any other task.

Very few holes have to be drilled — and most of these are for mounting the controls on the front panel.

One side of the smaller cake tin is cut out and this discarded side can be used to fabricate the shield across the valve socket and the VFO capacitor mounting bracket. Both cake tins are soldered together to form the chassis and panel arrangement as shown in the photographs.

The balanced modulator board is mounted by pushing the threaded mounting sections of the carrier balance potentiometers through holes in the chassis and front panel and bolting on with additional nuts. It is suggested that this board be mounted first. It still requires earth straps to "earth" the copper earth sections on the board to the chassis.

The VFO tuning capacitor (C27) is mounted on a small bracket made from another scrap of tin. This bracket is soldered in position. A Jackson Brothers planetary reduction drive is used as the dial mechanism. The VFO capacitor mounting must be rigid otherwise drift and frequency instability problems could occur. The bracket should be braced to the front panel with stiff wire straps.

The front panel switches (S1 and S2) and audio gain control should be mounted next.

The components above the chassis should next be fitted — meter, tuning capacitor, loading switch (S3), and final tank coil L10. Once these are positioned the VFO and mixer board can be mounted. This enables the valve sockct to be positioned. The shield

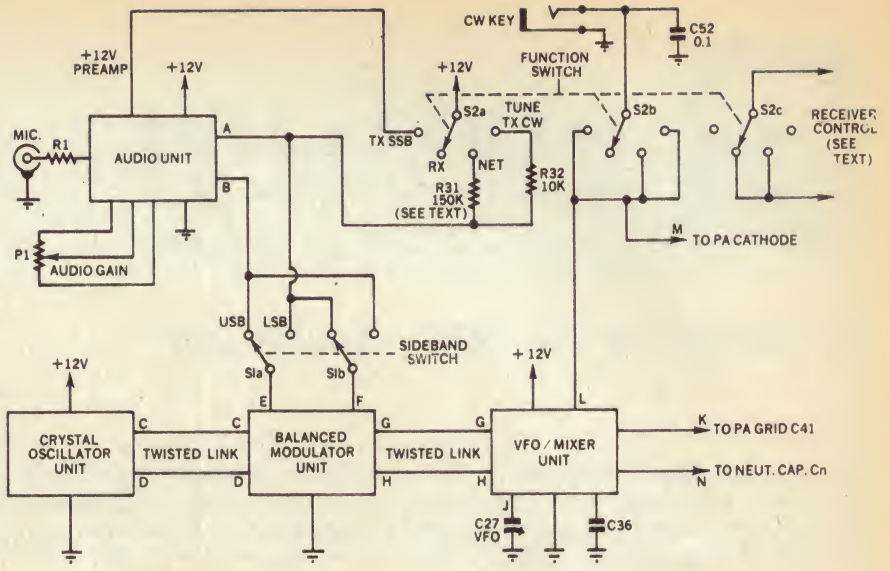


Figure 13: A diagram showing all the interconnections between modules.

across the socket can then be mounted.

The transformer can now be positioned. All the remaining components can then be mounted and the point-to-point wiring completed.

The printed boards of the prototype are mounted by using a solid copper wire mounting clip as shown in figure 14. The boards are held close against the tin by this method. Make certain that these mounting clips are soldered to the EARTH parts of the printed board and not to some other part!

Holes have been provided on the board patterns for conventional screw mounting if this is preferred.

The slug in coil L7 is removed and a 4-inch length of discarded plastic knitting needle is glued to it (I used Araldite). A hand-drill is used to bore a hole in the chassis under L7. This is most easily located by drilling through from the coil side down the axis of the coil. The knitting needle is then inserted through the hole. This enables the tuning of L7 to be accomplished from above the chassis. This control is labelled "mixer peak" on the top of the chassis. This simple method avoids the problem of providing and setting up wide-band tuned circuits. Make sure that the position of the mixer and VFO board is such that this knitting-needle control does not foul any above-chassis components (e.g. L10).

It is hoped that the photographs will assist with providing other details necessary for construction.

The third and final article in this series will describe the testing and adjustment of the rig. It will describe an audio oscillator, a dummy load and a wavemeter, all very useful aids around the amateur shack, and will also give coil winding details and a voltage table. Details will also be given for a modification to permit AM operation.

(To be continued)

FORUM

Conducted by Neville Williams

Challenge to the IREE: "Speak up!"

In his presidential address to the Institution of Radio and Electronics Engineers Australia, Mr. Angus Fowler challenged members to review their traditionally conservative attitude and to speak out boldy on matters which concern the electronics industry and its relationship with the public.

Traditionally, learned societies tend to be restrained in their pronouncements on public affairs, and the Institution of Radio and Electronic Engineers is no exception.

Its members are drawn from a wide range of departments, establishments and companies, many of which are involved in active competition. Within the Institution, however, members make a conscious effort to tone down their rivalries and their affiliations and to concentrate on matters of common technical interest.

This effort to co-operate and to avoid provocation has tended to carry over and to inhibit comment on matters outside the purely technical sphere. As a result, the IREE has often remained silent when it might logically have expressed responsible opinion and criticism.

Such reticence may well have a double-barrelled effect: It deprives the government of the day of a responsible and substantially independent opinion on matters which have technical implications; it also leaves the field open to those who are less reticent and possibly less well placed to take a detached view.

In his Guest Address at the 13th National IREE Convention in Melbourne (1971) Dr B. M. Oliver called upon engineers to seek a stronger voice in the business of government. The scientific and engineering fraternity provides the technological basis for modern society but, more often than not, they are content to leave administration to others "trained as lawyers, businessmen and entrepreneurs."

Subsequently, in his Presidential Address to the Institution, Mr Angus Fowler took up this broad theme and gave it a local application. He asked:

"What can we do to improve the quality of living? Would it be helpful if the Institution was to offer public guidance by commenting on subjects where our Institution can be expected to have expert opinion?"

Mr. Fowler continued:

Some topical subjects affecting the public and on which the IREE could be expected to have an opinion are:—

1. The use of misleading terms and untrue specifications to promote the sale of domestic electronic equipment. This applies particularly to imported products, e.g. the use of the term "peak music power" in the promotion of audio equipment, and domestic cassette tape recorders with (unqualified) "response from 30 to 16,000Hz".
2. Issue updated guidelines for potential purchasers of car radio, short-wave radio, colour TV, audio equipment and other electronic equipment of current interest to the public.
3. In the interests of safety draw attention to the flood of electronic equipment coming into this country and the need to have those of suspect design appropriately tested and inspected before use. Products referred to are those originally designed for 110V operation but modified for 240V operation, apparently without adequate attention being given to long term safety issues.
4. Draw attention, when justified, to incorrect and inadequate sampling, measurements, or tests on which consumer protection associations base their reports.
5. Draw attention of the authorities concerned to situations where wage or employment inequalities appear to exist that would justify investigation and possibly corrective action.
6. Continue to draw attention to the fact that engineers, scientists and technicians need to have an appropriate minimum standard of formal training and at the same time recognise that a man's qualification should be first judged on his achievements and demonstrated abilities and his attitude to study, and rate the source of his paper qualification of secondary importance. On the subject of qualification I suspect that on too many occasions one formal qualification is judged to be higher than another when the actual difference is not so much one of level or grade, but of a difference in course objective or a difference in emphasis on subject.
7. Due to the apparent inability of individual private companies to obtain an adequate market share to allow economical mass production, encourage the Government and Industry to co-operate and set up a joint specialised low overhead modern production unit to mass produce portable radios in quantities that will compete with overseas imported items in terms of price and better quality, and for distribution through regular retail channels. A market

Wurlitzer for Tauranga, NZ

Dear Mr Williams,

I read with great pleasure the article in your November, 1971 issue on Wurlitzer Organs. This subject is particularly dear to me as I am currently engaged in supervising the installation of a Wurlitzer pipe organ in the Tauranga Town Hall, NZ, and I thought you may be interested to know something of the installation.

The organ is a 2-10 Model H Wurlitzer and is Opus 1482. It was originally installed in the De Luxe Theatre, Wellington some ten years ago, was purchased by Mr Eddie Aikin who installed it in the Tokoroa High School Assembly Hall where it was played by Mr Tony Fenelon on at least one occasion. Mr Vic Hammett has also presented a concert on this organ.

The organ recently was put up for sale by tender, and the City of Tauranga's bid was successful. We are currently engaged in forming the two organ chambers, one on either side of the proscenium arch in the Town Hall, and we have high hopes that the work will be completed by Easter.

The organ was presented to the City of Tauranga by the Tauranga 20,000 Club, and all the work in the installation is a voluntary effort by organ enthusiasts of Tauranga. So far all of the materials required for the construction have been donated by local business houses.

We are hoping that when we open up this organ we will be on the regular schedule for organists visiting the Australian circuit.

I have been a subscriber to your Journal for the last fifteen years, and in every issue I find something of interest to me, and particularly the latest issue with the organ article.

I do not know whether you intend to print more on Wurlitzer organs, but if you do, it would be of great assistance to me, and possibly others, if you could give details of some of the solid state circuitry which is available for speeding up organ action. I understand that there is a solid state tremulant with variable speed and depth control which can be cabled in direct to the tremulant magnets. I have also heard that there is a solid state switching device which eliminates the magnets and pneumatics of both the keying relays and the stop relays.

If you have available any of this information it would be most useful as we would like to introduce solid state into the Tauranga organ. When we have this organ opened up it will be the only Wurlitzer Organ in New Zealand which is available for public performance, and we will accordingly be welcoming any Australian organists who are able to come to Tauranga and try out our instrument.

With kindest regards,
N. R. White (Chief Engineer)
Tauranga Electric Power Board
Private Bag, Tauranga, NZ.

exceeding ¼ million radios per year has been lost to imports, many of low quality. The recovery of this market through mass production, greater efficiency and better design would provide sorely needed loading for the local components industry and retain a viable operational defence asset.

8. Issue progress statements for public benefit from time to time on such subjects as FM, colour TV and Quadrasonic Sound.

In making such observations about these and other matters, Mr Fowler stressed that they were personal opinions and suggestions.

Even so, they represent a line of thought which the IREE membership as a whole would do well to consider carefully.

Unless it makes a very conscious effort to be otherwise, a learned society tends to be conservative, reticent, stuffy perhaps — and ineffective as a voice influencing Government policy. Enterprise and effort are necessary if traditional caution and traditional limits are to be set aside to encourage deliberate dialogue and debate outside the purely technical sphere.

It is one thing, for example, to examine the technology of FM broadcasting; it is quite another to debate relevant government and commercial policy and to be heard in the marketplace expressing support or condemnation, as appropriate.

It might be unfair to imply that the Institution has never to date expressed itself in matters of policy. It would doubtless be possible to summon evidence that it has supported a variety of causes, including FM broadcasting, colour television and, more recently, an audio / hi-fi industry group.

But equally it might be contended that the effective weight of professional opinion is not appropriate to the amount of technical and commercial expertise that is resident in the IREE membership.

Be that as it may, the current President, Angus Fowler, has set the ball rolling with his address, which is reproduced in full in the December "Proceedings". It is up to the members to "kick it around" in the constructive sense.

Customs and Tariff

Reproduced below is a letter from a reader in Western Australia. It is to the point and brief enough to be presented in full. Maybe it reflects your own feelings.

Dear Mr. Williams,

Just a note to express my very deep disappointment at your article "Forum" in the Jan issue of "EA."

I believe that up to this time you have been one of the leading and most effective voices for the amateur body on this inequitable issue. Your sudden and complete about face left me dismayed to say the least, as I feel sure it has hundreds of others.

If the Government has lacked seemingly plausible reasons for maintaining this protection of non-existent Australian industry, then surely your article will be greatly welcomed by them.

In your discussion you mention two Australian companies being "left in the role as the villains of the piece". One can only wonder now whether there are not several more villains who have brought pressure to bear to "cool" the increasing agitation for the freeing of amateur gear.

With best wishes,

D.L. (Kambalda West, WA.)

D.L. sees the January "Forum" as an about-face; as a selling of a cause down the drain!

I see it as an attempt to be objective — perhaps unpalatably so. It was certainly not a response to pressure, either from the firms mentioned or from any other firms. After all, if the article had been inspired by pressure, it would hardly have included in a panel the names of the firms concerned.

To be sure, the amateurs have a cause and, as our correspondent concedes, "Electronics Australia" has sought to publicise that cause.

But, equally, when the victory was lost just when it seemed to have been gained, there tended to be a somewhat immature reaction. To many amateurs it was such a simple cause, uncluttered by other considerations: simply let amateurs import transceivers on a duty-free basis; obviously, any firm which opposed such a proposition could be motivated only by sour grapes!

In fact, publication of material during 1971 espousing the amateur cause triggered off a good deal of discussion and underscored some of the points raised in the January Forum.

If amateurs can establish a right to obtain transceivers from overseas duty-free, should not local manufacturers be given the right to compete for the amateur dollar by being allowed to build receivers from duty-free components?

Is the amateur cause really unique?

Are even "unique" causes involved in the overall planning of the country's economy?

In criticising the January Forum, D.L. does not contest any of the points we raised. The burden of his letter seems simply to be: "What you say may be the truth but I am dismayed that you said it!"

There might have been room for disappointment if we had alerted the authorities to something they did not already know; or provided them with ammunition they did not already have.

In fact, the tariff and customs people are extremely aware of the pressures which operate in matters of this kind.

If amateurs are to win the day, they will have to do so in the face of such pressures, and in full knowledge of them. They will have to establish their cause as sufficiently worthwhile and unique to warrant special consideration. They will have to demonstrate that local manufacturers cannot realistically control their stocks and documentation to negotiate worthwhile customs rebate on the contents of a few specific transceivers.

They will have to demonstrate that local transceivers are too expensive and likely to remain so.

That the only practical way to assist the amateur movement is for the Government to treat it as a special case, to forgo a negligible amount of revenue and to admit amateur band transceivers duty-free.

There is a world of difference between pleading a cause in the full knowledge of all the difficulties involved, as against the illusion that there is nothing to it.

THE SERVICEMAN

Tracking down an interesting intermittent

Two stories sent in by readers are presented this month. First I have a very interesting and instructive intermittent fault to describe, followed by the story of a new loudspeaker that was incorrectly labelled.

This story comes from one of my readers, Mr R.Z. of Queanbeyan, N.S.W. He was inspired to write it after reading one of my stories in the May issue of last year, his story bearing some resemblance to this, at least in regard to the basic fault.

However, I am prompted to present the story for other reasons. One is simply that it concerns an intermittent fault, and I believe that we can never have too many examples of how these faults occur, and how to track them down. For another, I regard this story as a classic. It has all the ingredients of a typical intermittent fault; the intermittent symptoms, the preliminary observations and assessment of the general location, the systematic monitoring of the suspect section with all available instruments, the extreme touchiness of the fault while being investigated, and the final narrowing down, with successive failures, to the actual fault.

It is also an excellent example of what can be done with ordinary facilities and equipment, simply by approaching the problem methodically. Even the lack of a circuit need not be an insurmountable barrier. Here is Mr R. B.'s story.

I am an ex-TV technician and am often asked by friends to repair their TV sets. As I still own a few pieces of test equipment and most of the more common valves und transistors, I normally accept the challenge, if only to keep my hand in.

The TV set was part of a 3 in 1 combination, about 10 years old, and of a make which has since gone off the market. The fault was intermittent loss of picture, about an hour or so after switching on. Usually, the picture tube went black, accompanied by partial or complete loss of sound. At other times the picture went dark with loss of sync and lack of contrast. Flashing was also noted at odd times.

On being switched on for a demonstration the set produced a normal picture, but I noticed that changing channels caused the fine tuning control to behave erratically. This was a minor fault which the owner had forgotten to mention. I made a mental note to do something about it when the main fault had been found and fixed. I also noted that adjusting the brightness control indicated that the EHT regulation was anything but good, and made a note to check the 1S2 EHT rectifier.

While waiting for something to happen I removed the back of the cabinet and tapped a few valves, in the hope that it might bring on the condition. As I tapped the 6AL3 boost rectifier, severe internal arcing occurred. I fitted a new 6AL3 and wondered if I had fixed the intermittent. However, about 30 minutes later out went the picture and down went the sound. Turning up the brightness revealed a weak picture with loss of sync.

Purely on spec, I fitted a new 6DX8 video amplifier / AGC valve. This restored the picture, but only for about 10 minutes. A few other valve substitutions were tried but proved fruitless. I also checked the AGC controls by slightly adjusting each one while watching for any abrupt changes in picture behaviour, but all seemed OK. By now it was obvious that the set would have to come out of the cabinet and set up on the work bench where the various suspect circuits could be monitored. Also, some work was obviously necessary on the tuner. Fortunately, the owner had a second set.

Back at the workshop I set up the chassis on the bench, underside facing out, plugged in the yoke, and connected an aerial. The EHT lead was kept out of harm's way by pushing it into a glass jar on the bench — a useful tip for controlling this, by the way.

Not having a circuit I did the next best thing and traced out the wiring for the video amplifier and AGC section. The circuit appeared to be approximately as shown.

Then I connected a CRO to the video detector output and a VTVM to the AGC line. I switched on and, while watching the CRO, adjusted the fine tuning and contrast control to produce a good video pattern and about 2V P / P video out of the detector. The AGC voltage to the IF was about —6V.

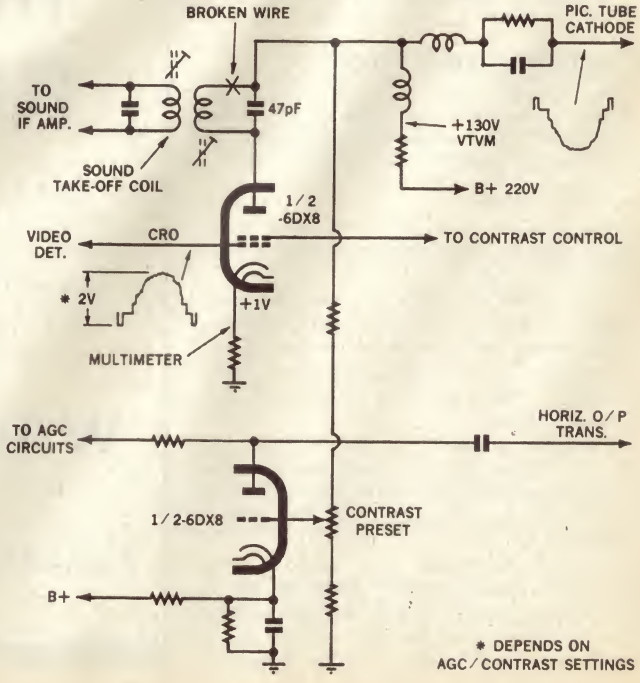
Line time base synchronisation was confirmed by checking the phase comparator, and vertical synchronisation with the CRO, which was then returned to the video detector output. I felt I was now ready to make useful observations the next time the set failed. All I had to do was wait.

It didn't take long. The set had only been on for about 20 minutes when the AGC voltage suddenly increased from —6V to —60V and the video detector's output dropped to zero. Small wonder with that kind of AGC voltage. I tried to measure the voltage at the video amplifier anode, but the mere action of connecting the meter prod brought everything back to normal.

I fitted another 6DX8 valve on the off chance that my test valve might have been faulty. I left the CRO connected to the video detector output, connected a multimeter across the video amplifier cathode resistor (normal reading +1V), and connected the VTVM to the junction of the video load resistor and the peaking coil (normal reading +130V). Then I waited again.

After some time, when nothing happened, I became impatient. I picked up a screwdriver and gave the chassis a sharp tap near the 6DX8 socket. Success! The fault recurred; video detector output zero, 6DX8 cathode bias up to 2V, junction of video load resistor and peaking coil +220V, the full HT voltage.

I gently unclipped the VTVM lead and transferred it to the anode of the 6DX8. This time luck was with me. The condition was not disturbed and the voltage was zero. Next I moved the VTVM to the other side of the sound take-off coil. It showed +220V again. I was getting close.



The circuit of the video amplifier and AGC section of the faulty TV receiver, as determined by R.Z.

Removing two nuts allowed me to remove the offending coil's metal shield and a pair of tweezers soon located a broken connection. It was a clean break, the 47pF resonating capacitor having been pushed back against the lead, causing it to be stressed. A bump or vibration did the rest and it became a temperature sensitive connection.

It was a simple matter to re-solder the connection and re-dress the lead so as to leave a reasonable amount of slack in the wire. Finally the coil was re-aligned, although it needed very little adjustment.

I spent a short time cleaning the fine tune mechanism, which cleared up that problem. I also replaced the electrolytic block, as it was bursting at the seams, even though it checked OK. Better to be sure in a case like this. Finally, I fitted a new 1S2 valve.

On refitting the chassis to the cabinet, only picture height and similar minor adjustments were needed to produce a first-class picture.

And so another nasty intermittent was found and fixed.

Well, thank you R.B. for a most interesting story. I suggest that any up and coming servicemen among my younger readers should try it in detail. There are a number of lessons you can learn.

And now another story sent in by a fellow serviceman. This concerns a wrongly labelled loudspeaker which led him astray for a while.

A recent service job concerned a locally made portable radio which — according to the owner — had "just stopped". It was a model which uses no output transformer, the collector load of the push-pull output stage being a high impedance centre-tapped speaker.

It was quickly determined that the speaker was open circuit in both halves — making me wonder whether one half had been open circuit for some time and the resultant distortion unnoticed. However, that is simply speculation.

A new speaker was ordered, and subsequently installed. This brought the set to life, but with very bad distortion. Voltages around the output stage were checked and appeared normal. The signal into the output stage was quite clean. Finally the big guns had to be called in on what should have been a simple repair.

An audio oscillator was connected to the input of the audio stage and the output signal observed on the CRO. Output from one of the push-pull transistors was very distorted. Could it be a faulty transistor? The pair was changed, but there was no improvement.

Finally, almost in desperation, the collector leads going to the speaker were transposed. This did not alter the distortion, but it now appeared at the output of the opposite transistor.

I looked at the brand new speaker with suspicion. Disconnecting it I made a few measurements with the low ohms range of the multimeter. My suspicion was confirmed; the terminal labelled "C.T." was not in fact the centre tap.

I identified the true centre tap, transposed the leads, and "Hey Presto", the distortion vanished.

I wonder whether this speaker was an isolated case, or whether others had been fooled as I was. (R. J., Glen Waverley, Victoria.)

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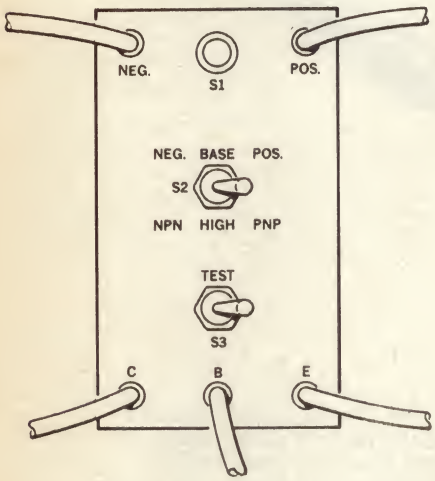
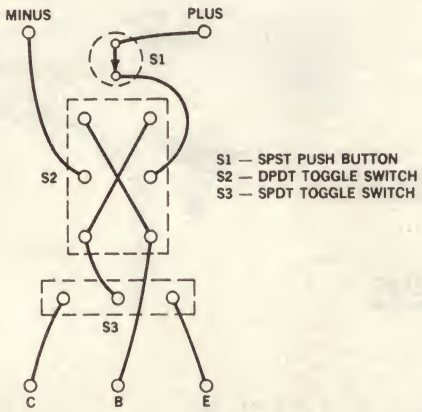
CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected by the Editor from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome.

An Ohms Transistor Checker





"Transistor Testing: What With?" by Jack Darr in the November 1969 issue was a fine article. However, reversing probes and holding the transistor can be a little awkward. Why not get the idea off the ground? Build an Ohms Transistor Checker that will make ohms checking a snap. The wiring diagram indicates the simplicity of the checker and the other diagram shows the panel. Your ohmmeter connects to the plus and minus leads via short leads with alligator clips. The transistor is similarly connected to the checker's collector, base and emitter terminals.

Set the ohmmeter to the proper range and push switch S1. Move switch S2 either to left or right to obtain a high ohms reading. Now move S3 to the left to test the base-collector junction. Move the switch to the right and test between the base and the emitter.

The transistor leakage factor is quickly obtained by moving S2 to the opposite side. Again S3 makes the test between the collector and emitter. A wide variation in readings between the test at the collector and emitter indicates a defective transistor.

The polarity of the voltage on the ohmmeter leads should be so that with S2 at the right (POS-PNP), a voltmeter with its plus lead to the base terminal and the negative to the emitter with switch 3 to the right you have a positive reading on the meter. The setting of S2 now lets you determine the sex of the transistor.

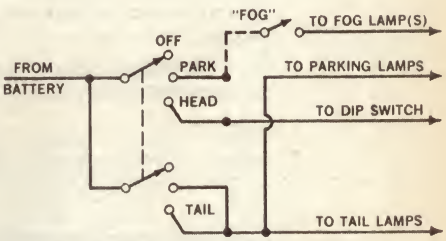
Pnp or npn? Connect the transistor to the collector, base and emitter leads. If the high reading comes with S2 set to NPN, the transistor is an npn. It is a pnp when the high reading occurs with S2 set in the PNP position. (By H. Lindon Robinson, in "Radio-Electronics".)

More on Road Safety

I was interested in the idea which was submitted by Mr. Fisher in the October issue, to ensure that the parking lights are still on when the head lights have been switched on. An alternate idea, which I believe is simpler and perhaps cheaper, is to identify the parking light wire at the light switch and connect it to the tail light terminal of the switch.

By doing this, the parking lights will be on with the switch in either the "park" or "head" position. An extra possible facility arising from this, is that the now vacant parking light terminal may be used, via an extra switch for fog lights. This method of connecting the fog lights ensures that the fog lights are off when the headlights are on and vice versa.

(By Mr. G. D. Mayman, 11/153 Smith Street, Summer Hill, NSW 2130.)



A 400V 50W DC-DC Inverter

Here is a DC — DC inverter with 400V DC output and capable of 50 watts. It may be used in place of the inverter described for the Capacitor Discharge Ignition system described in August, 1970. On the other hand, there are many applications for such an inverter and the output voltage may be varied by making suitable adjustments to the number of turns on the transformer secondary.

This design is attractive in that it is compact, economical and efficient. Perhaps the heart of the unit is a Philips ferrite toroid, type No. 4322 020 36570 and the turns and the general design are specifically for this particular toroid.

Before any winding is commenced, the toroid should be wrapped with a layer of mylar tape to prevent any possible break down to the core. The secondary is wound first and this consists of 275 turns of 26B&S enamel wire. This winding consists of about 16 yards of wire and this should first be wound on a 3in long pencil. Winding is then achieved by passing the pencil through the hole in the toroid. The secondary takes up about two layers on the core. Between each layer, place another layer of mylar tape, together with another layer over the finished winding.

The primary winding is bifilar wound with two wires together of 16B&S enamel. Ten turns are wound with the windings spread around the full circumference of the toroid. The start of one winding is connected to the finish of the other and this becomes the centre tap, with ten turns on either side.

The feedback winding is wound in a similar manner to the primary, again with the start of one winding and the finish of the other, connected to become the centre tap. It is not necessary however, to spread the

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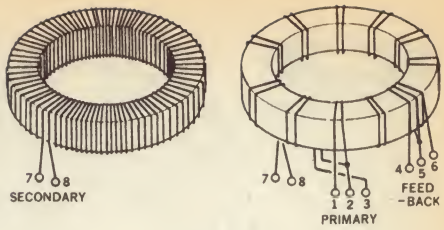
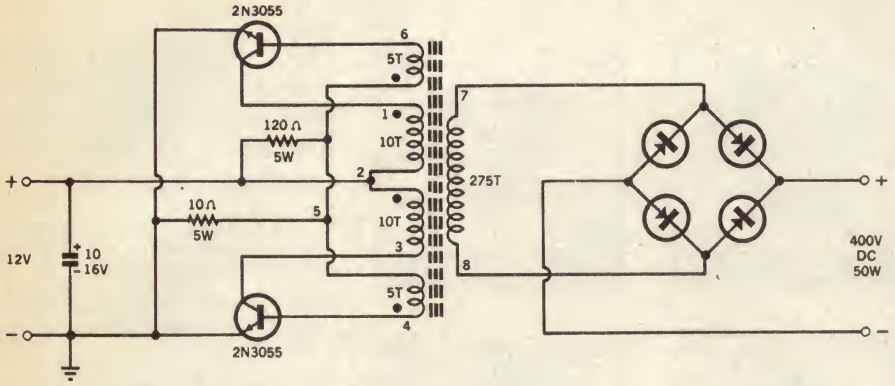


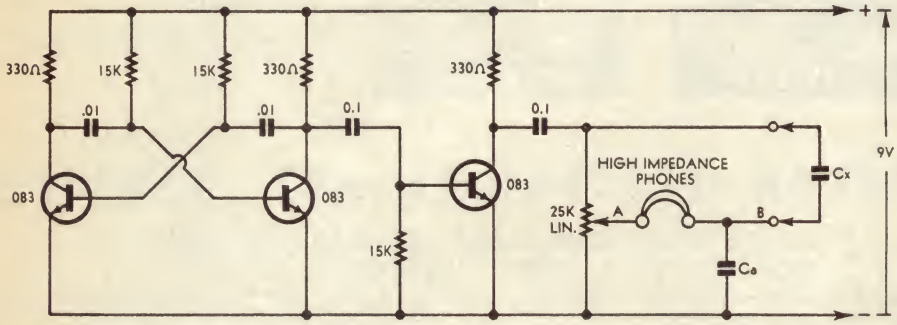


turns of this winding and they may be simply wound in one concentrated region. It would also be wise to add a layer of mylar tape between the primary and feedback windings. Finally, a layer of mylar tape is used to cover the finished windings and if facilities are available, the transformer may be vacuum impregnated.

Winding details are shown in the diagram.

(By Mr. J. Nowosad, B.E., 2/33 Stuart Street, Canley Vale, NSW 2166.)

A Simple Capacitance Tester



This is the circuit for a capacitance tester which I have made from some computer board components.

The first two transistors function as a pair in an astable multivibrator, at a frequency of about 5KHz. The output from the multivibrator is amplified by the third transistor. The output from the multivibrator is amplified by the third transistor. The output from the amplifier, via a 0.1uF blocking capacitor, appears across a 25K linear potentiometer. The same output is also impressed across two capacitors in series.

Although the capacitor Ca should have a nominal capacitance of .01uF, it need not be accurate but a good stable unit is most desirable. The unknown capacitor Cx, with the capacitance of Ca, form a voltage divider and the voltage appearaing at point B will be determined by the ratio of the two capacitances.

A pair of high impedance headphones is connected between points A and B. The voltage at B is already established by the two capacitors and when the rotor of the potentiometer is adjusted so that the voltage at A equals that at B, sound which was audible in the headphones, will go through a "null" at this point.

Before this arrangement can be made use of, a dial scale attached to the rotor of the potentiometer will have to be calibrated in terms of capacitance. To do this, several capacitors giving a wide range of known values, are required. As each capacitor is connected into the position for Cx, the potentiometer is adjusted for the null and this point is a calibration corresponding to the value at Cx. A sufficient number of points must be provided on the scale to complete the calibration.

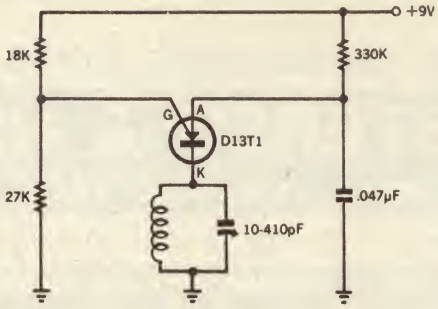
(By Mr D. Lia, 36 Oakhill Avenue, Reservoir, Victoria 3073.)

(Editorial comment: More than likely, the transistor type used by the author will not be available to readers. However, we can see no reason why many of the NPN small signal silicon types readily available, should not be satisfactory.)

Novel Broadcast Test Oscillator

This is a simple RF test oscillator, suitable for broadcast receiver alignment. The time constant consisting of the 330K resistor and .047uF capacitor gives a repetition rate of about 10 per second. Each pulse shocks the tuned circuit into oscillation, the frequency of the latter being determined by the LC constants. The resultant signal is heard as a strong tone in the receiver. The coil may be an old broadcast coil or a ferrite rod, 8in x ⅜in, with about 80 turns of 32B&S enamel wire.

(By Mr S. Lester, 524 Willoughby Road, Willoughby, NSW 2068.)



Simple Radio Receivers

Limitations of a diode or "crystal" set — amplified crystal sets and audio amplifier stages — active detectors and their operation — reaction or regeneration — two stage receivers with transformer and resistance-capacitance coupling — additional audio stages — output power considerations — overload and gain or volume control.

Having used the crystal receiver to learn some of the basic facts about radio reception, we are now in a position to discuss simple transistor and valve receivers.

As we saw in the last chapter, a crystal set is a very useful and interesting device. It is simple to make, it costs nothing to operate and it demonstrates, in a practical way, many important radio principles.

For all that, however, a crystal set has very serious limitations. The only energy available to it is the radio frequency energy picked up by the aerial and earth system from the desired transmitter. This is selected, demodulated and made available to the earphones as an audible signal.

As the distance between receiver and transmitter is increased, the energy available becomes less and less until, at a distance which may be as little as 25 miles, the signal becomes inaudible. Only in very exceptional circumstances are the signals from a crystal set ever strong enough to operate a loudspeaker.

Yet another serious problem is that of poor selectivity, a crystal set often being unable to separate the wanted signal clearly from other strong signals in the receiving area.

In the face of such limitations, it is not surprising that engineers, very early, sought to improve the performance of crystal receivers or, alternatively, to supplant them altogether. Nor is it surprising that they have been relegated, in this modern age, to the role of a "beginner's set."

As you have probably guessed, the answer was found in a device we have already discussed — the thermionic valve. If you've forgotten this earlier discussion, we suggest you turn back to chapter 6.

Strangely enough, the very first valve receivers were no more ambitious in their performance than crystal sets — in fact, there were plenty of early radio operators of the day who claimed that they were not as good.

These early valve receivers were just like crystal sets, in fact, except that they used a diode in place of the metallic crystal and "catswhisker" detector.

As we explained in the earlier chapter, diodes exhibit the same rectifying properties as a crystal, being able to pass current only in one direction. They make signals audible in the phones by the same process as explained for a crystal set.

The main advantage of the valve or thermionic diode was that it needed no critical adjustment. This advantage was very real in a day when the surface of crystal diodes had to be probed with the "catswhisker" contact to discover a sensitive spot.

Against this, of course, the diode valve needed a filament battery, which was something of a nuisance. Hence the arguments of the day as to which was the better proposition.

The development of the triode valve settled such arguments, because it brought with it the ability to amplify the incoming signals. Instead of being utilised to operate the phones directly, the signals were applied to the grid to control plate current

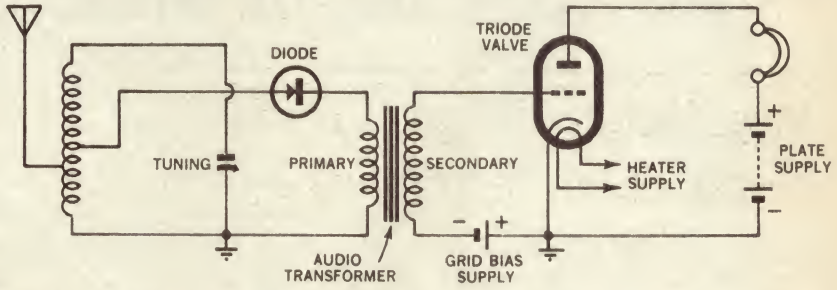
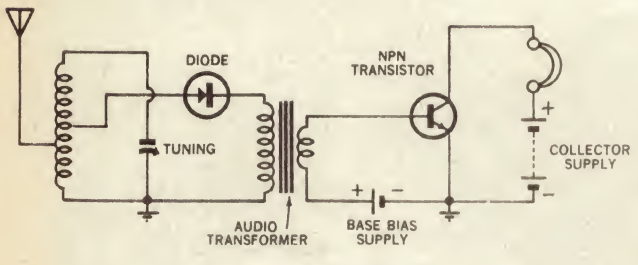
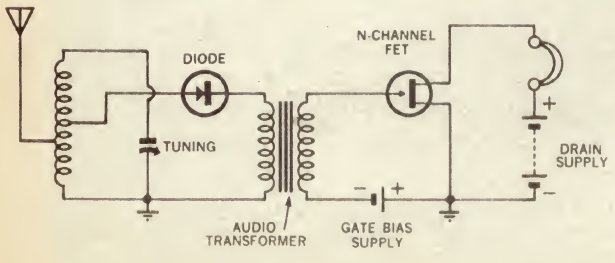


Figure 1: An early type of receiver which used a triode valve to amplify the demodulated signals produced by a diode detector circuit.



(a) NPN BIPOLAR TRANSISTOR



(b) N-CHANNEL FET

Figure 2: Bipolar Transistor and FET versions of the receiver in figure 1, showing the similarities between the three types of device.

flowing from a B-battery. The resultant and larger plate current excursions, dependent on the grid signal, produced much louder signals in the phones.

Figure 1 shows a type of receiver which was quite popular in its day — the combination of what is virtually a crystal or diode receiver and a triode amplifier stage.

The incoming signal is selected by the tuning circuit and applied to the detector. This later may be either a semiconductor diode or a thermionic diode, which suppresses half the incoming carrier and delivers to its output circuit what we described, in the last chapter, as a series of unidirectional pulses proportional in strength at each instant to the modulated carrier.

Instead of being passed directly through the phones, to produce an audible sound, these pulses are passed through the primary winding of an audio transformer. Perhaps we should pause here to explain these terms, at least in brief.

The word "audio" comes from the Latin verb "to hear" and is used in electronics to describe any circuit or component which

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handles signals at a frequency within or adjacent to the range of sound frequencies. Thus an audio amplifier stage is one which amplifies signals at audio frequencies.

By the same token, an audio transformer is one which is designed to handle, or transfer, or couple signals at audio frequencies.

The principles of transformers generally have been discussed in an earlier chapter and obviously cannot be repeated here. An audio transformer is usually wound on a core made up from iron laminations. It normally has two windings, and each may comprise many thousands of turns of fine wire.

The input signal is fed to the winding normally referred to as the primary, while signal is taken for the following circuit from the secondary.

It is possible to secure a step-up in signal voltage from a transformer by winding more turns on the secondary than on the primary. Old-style transformers, which often come into the hands of experimenters, typically have a turns ratio of 1 to 3 or 1 to 5 from the primary winding to the total secondary winding. More modern transformers intended for transistor circuits may have less turns on the secondary than on the primary. This gives a step-down in voltage, but a step-up in current.

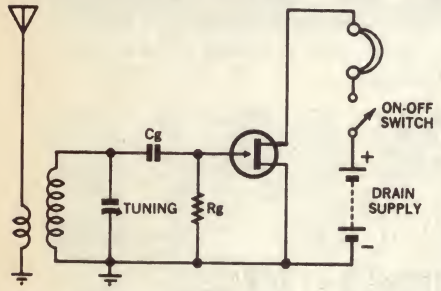


Figure 3 (above): The basic circuit of an active detector circuit using a FET. Figure 4 (right): The way in which the performance may be improved by applying positive feedback or "reaction".

Now back to figure 1.

The signal currents from the diode detector flow through the primary winding of the transformer. Now the transformer is no more able to respond to individual unidirectional carrier pulses than the earphones referred to in the last chapter.

However, the current through the primary winding, and therefore the magnetic field it produces in the core, tends to merge into a pattern, which follows the rise and fall of the incoming carrier with modulation.

The changing magnetic field, due to current through the primary winding, induces current in the secondary winding and a corresponding signal voltage between its two ends.

These two ends are connected respectively to the grid and cathode circuit of a triode amplifier valve and the audio voltage between them therefore constitutes a grid signal controlling the flow of electrons through the valve from cathode to plate.

For the reasons explained in chapter 6, a bias voltage is normally provided to keep the grid slightly negative with respect to filament, the optimum bias depending on the type of valve and its other operating conditions. When the incoming signal carries the grid more negative than the standing bias, current through the valve is reduced. Conversely, when the signal makes the grid less negative, current through the valve is increased.

This ever-changing current, flowing from the High Tension or B-battery through the phones produces much more output from the phones than could the small current pulses available from the detector.

Figure 2 shows the circuits for receivers which are the transistor and FET counterparts of that in figure 1. In (a) an NPN bipolar transistor is used in place of the triode valve, and is supplied with base bias voltage and collector supply voltage with the polarities shown. The audio transformer used with the transistor usually has a step-down primary-secondary turns ratio rather than a step-up ratio, because as we saw in chapter 7 transistors have a relatively low input resistance and are current amplifiers rather than voltage amplifiers.

While fewer turns in the secondary of the transformer than in the primary give a step-down voltage ratio, as mentioned earlier it actually gives a step-up current ratio, and this suits the transistor perfectly. It also "matches" correctly the relatively high-resistance detector circuit in the primary and the low resistance transistor input circuit connected to the secondary.

Figure 2(b) shows how an N-channel FET would be used in a similar type of simple receiver. The circuit is very similar to those for the valve and bipolar transistor versions, as may be seen. Note that the polarity of the gate bias supply is opposite in polarity to the drain supply, pointing to the similarity between FETs and thermionic valves.

Simple receivers along the lines of figures 1 and 2 are capable of substantially better performance than an ordinary crystal set. Sound volume from near-by stations is increased. Range is effectively improved because signals which might otherwise be inaudible are amplified to listenable strength.

Even the effective selectivity can be improved because amplification from the audio stage allows the tappings on the coil to be moved closer to the earthed end, than would otherwise be the case. Selectivity is improved as a result.

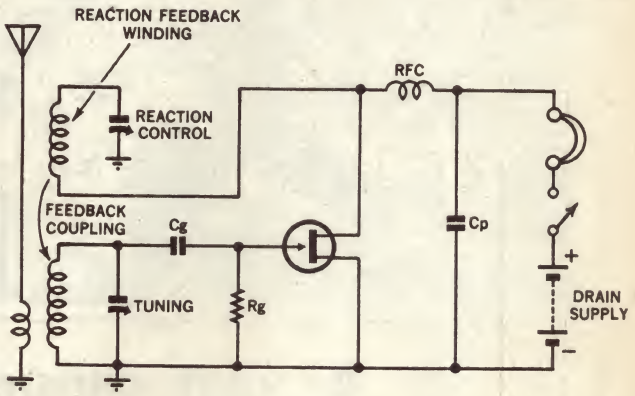
Still further improvement would be possible by providing two or even three audio stages after the crystal detector. In practice, however, this is seldom done because better overall performance can be obtained by following different circuit principles, at least for simple beginner's type receivers.

What is involved, primarily, is the elimination of the crystal or diode detector and the substitution of an "active" detector stage using a transistor, FET or valve.

Figure 3 shows the basic circuit for a simple receiver using an N-channel FET as an active detector.

To understand its operation, one must remember that the gate and channel regions of a FET are separated by a P-N junction which is virtually identical with the P-N junction of a normal semiconductor diode. Normally, the junction of the FET is reverse-biased, and its depletion layer is used to control the source-drain current flowing through the channel. But if the gate-channel junction is forward biased. it will itself conduct current, just like a normal diode.

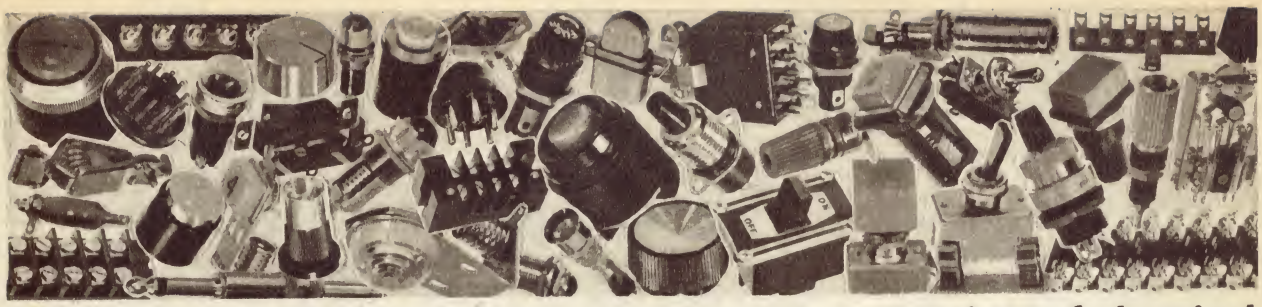
Now in the circuit of figure 3, the input signal selected by the tuned circuit is fed to the gate of the FET through a coupling capacitor marked "Cg" (this kind of notation is often used to facilitate discussion of electronic circuits, by the way; thus "Cg" is short for "capacitor connected to the gate", and so on). In a typical circuit, the value of the capacitor might be between about 100pF and 470pF. There is no fixed reverse bias on the gate of the FET, so that the gate-channel junction will tend to be forward biased during each positive half-cycle of the RF input signal, and reverse biased during the negative half-cycles.



During the half-cycles in which the junction is forward biased, it conducts current. The pulses of current which flow in this fashion tend to charge up capacitor Cg to the peak value of the RF voltage developed across the tuned circuit. There is thus built up across the capacitor a DC voltage whose size is proportional to the peak value of the RF input voltage, and whose polarity is such that it tends to reverse-bias the gate-channel junction of the FET — ie, in this case with negative connected to the gate.

The gate-channel junction of the FET naturally cannot conduct current during the half-cycles of the RF input voltage which tend to swing it in the direction of increased reverse bias. In fact during these half-cycles the charge on capacitor Cg tends to "leak away" through resistor Rg. The discharge current flows down through Rg and back up to the capacitor via the low resistance of the tuned circuit coil.

Far from being undesirable, however, this discharging action is actually necessary if the circuit is to be used to detect or demodulate any audio or other



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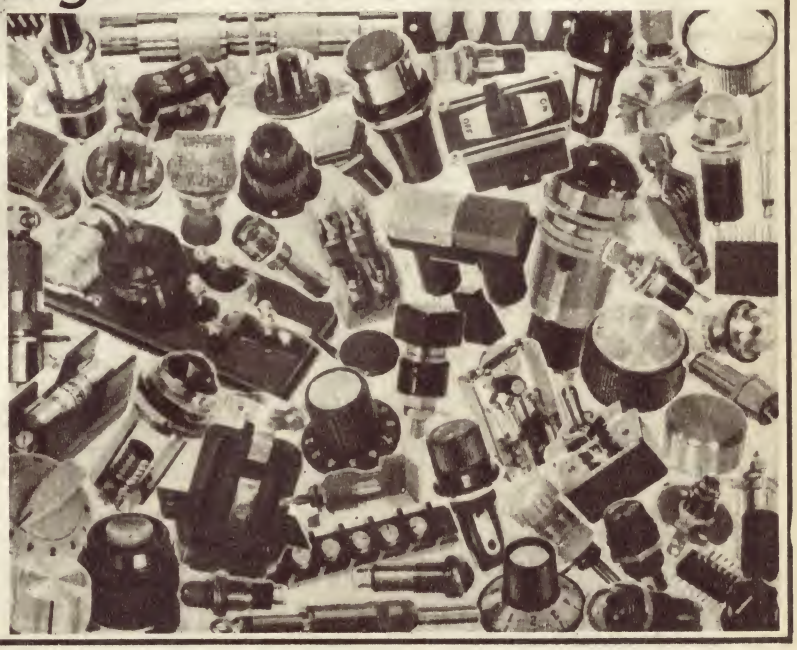

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information impressed on the RF signal. Without resistor Rg, the charge on Cg would simply rise to a value corresponding to the highest positive peak of the input RF voltage, and stay at this value. Even if the RF signal were then completely removed, it would tend to remain at this value, dropping only very slowly due to leakage through the FET and through the dielectric of Cg itself.

In a nutshell, the "gate leak" resistor Rg is necessary to ensure that the charge developed by capacitor Cg due to gate current flow can leak away fast enough to follow any downward changes in RF signal strength. Resistor Rg is thus given a value such that it can discharge Cg fast enough to correspond to the "downward slopes" of the waveform of the highest modulating frequency which it is desired to detect. This value usually lies between about 220K and 2.2 megohms.

Capacitor Cg, resistor Rg and the gate-channel junction of the FET thus act as a detector circuit very similar to that in the "crystal" receiver described in chapter 10. The flow of gate current during positive peaks of the RF voltage developed across the tuned circuit results in the building up of a unidirectional charge across Cg, and because of the action of Rg this charge is able to vary in size to follow faithfully any variations in the RF signal corresponding to modulation.

But this is only half the story. While the gate-channel junction of the FET is thus arranged to function as a detector, the FET as a whole is still able to function as an amplifying device. Because the drain-source current is related to the gate-channel bias by the transconductance, as we have seen in chapter 7, the varying reverse bias developed across capacitor Cg by the detector action results in magnified variations in the average drain current flowing through the phones. The sounds produced by the phones are thus considerably louder than they would be if the phones were connected directly into the detector circuit.

It is because this type of circuit performs both the functions of detection and amplification together that it is called an "active detector".

Although the circuit of figure 3 uses an N-channel FET to illustrate the operation of an active detector, other devices can be made to operate in the same way. Thus a thermionic valve may be substituted for the N-channel FET, and would operate in virtually identical fashion provided it was supplied with filament or heater power and a suitable plate supply. A P-channel FET could similarly be used, simply by reversing the polarity of the drain supply.

NPN and PNP bipolar transistors may also be used as active detectors, although these require a slightly different biasing circuit to work efficiently.

Although an active detector circuit of the type shown in figure 3 is quite interesting from a technical viewpoint, as it stands it cannot boast any special order of performance. The performance is not markedly different from the circuits of figure 1 and 2, in fact, so that the main advantage offered is that it eliminates the need for a separate detector diode and an audio transformer.

That is not the end of the story, however. A simple addition to the circuit can make an enormous difference to the whole performance. It involves the use of reaction or regeneration or positive feedback, terms which all mean much the same thing. Figure 4 shows a FET detector incorporating what is probably the best-known reaction circuit.

It must be emphasised that this is not by any means the only possible arrangement for a receiver using reaction. It is a popular and typical arrangement but it would be possible to produce a quite imposing article on the many circuits which have been evolved during the last 30 or 40 years around regenerative detectors.

The tuning, detection and amplifying action are basically the same as for figure 3. However, advantage is taken of the fact that, over and above the detected audio voltage, there is present on the gate of the detector some of the original RF input signal. This is amplified and the signal at the drain contains the audio component, which operates the phones, plus an amplified RF signal.

When reaction is employed, this amplified RF signal is coupled back into the tuning coil in such a way that it adds to the signal energy already present. This involves placing a reaction winding close to the tuned winding and so arranging the connections to it that the signals tend to add rather than to cancel.

Assume, for example, that there is a positive signal pulse at the gate at a particular instant. This increases the drain current and causes a negative pulse at the drain. By impressing this pulse across the reaction winding and suitably arranging the connections, its phase can be reversed; ie, coupled into the tuned winding as a positive signal. This augments the original signal and produces a far greater total effect on the drain current than would the original signal without the feedback.

The effect of this type of feedback, therefore, is to make every positive signal excursion much more pronounced than it would normally be and every negative excursion likewise. The changes in signal level due to modulation are made much more evident and therefore the audio signal delivered to the phones is greatly increased.

The letters "RFC" in the circuit stand for "radio frequency choke." This component, which is usually a honey-comb-wound coil, is inserted between the drain and the phones to ensure that RF energy at the drain is not bypassed to earth by capacitance of the phone cords. The RF is therefore retained for use by the reaction feedback winding and control.

At the same time, RF energy is undesirable in the phone cords, because it can radiate into space and back into the aerial tuning circuit, causing the reaction adjustment to be upset by random movement of the phone cords or even by the person wearing the phones.

The radio frequency choke (inductor) is intended to prevent this trouble, its effect being augmented by the capacitor Cp shown in the circuit. This bypasses any RF energy to earth which may still be present but it does not bypass the audio components, which have a much lower frequency than the RF carrier.

Again, although figure 4 shows an N-channel FET in the circuit, the principle of regenerative or reaction feedback can just as easily be applied to active detectors using other devices. And active detectors using thermionic valves or bipolar transistors, show an equally marked improvement in performance when this is done.

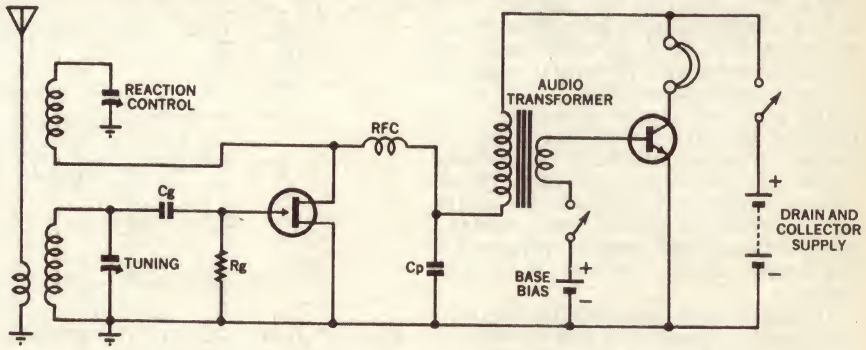


Figure 5: The addition of an audio amplifier stage to further increase sensitivity. In this case the amplifier is shown using a bipolar transistor, and is coupled to the detector using an audio transformer.

For a regenerative detector of this type to operate correctly it is most important that the amount of feedback be properly adjusted. If there is insufficient feedback, only limited benefit is obtained from the scheme. If there is too much feedback, the detector will oscillate of its own accord and begin to act as a generator of RF energy, exactly as described in the chapter on radio transmitters.

To give the necessary control over reaction it is customary to connect a small variable capacitor in series with the reaction winding, as shown in figure 4. When this is fully meshed, maximum RF feedback current can flow from plate, through the reaction winding to earth. As the capacitor plates are opened, the impedance of the circuit rises and less feedback energy can flow through the coil.

To adjust the reaction in bipolar transistor circuits it is sometimes more convenient to place a potentiometer across the feedback winding.

When the reaction control of the circuit in figure 4 is set so that the detector is just below the point of active oscillation, the gain and selectivity of the detector and its tuning circuit is increased enormously. Used with an efficient aerial and earth, a one-FET or one-valve or one-transistor reaction set can receive signals under favourable conditions from transmitters thousands of miles away.

From the foregoing description, it might

possibly be assumed that a one-stage regenerative set is all that should even be necessary to receive radio signals. But such is not the case.

Compared with a crystal receiver, a one-stage set has an enormous advantage in terms of sensitivity and selectivity — terms which relate to its ability to pick up a wanted signal and separate it from other signals. For all that, however, its performance is still capable of substantial improvement.

For example, the signals heard in the phones from a distant station may be quite weak, requiring a good deal of concentration to follow them. The usefulness of the set can be increased greatly by adding an audio amplifier stage after the detector, exactly as already described in figures 1 and 2 for a crystal set.

This gives a basic circuit such as that shown in figure 5.

As before the FET is used as a regenerative detector but, instead of its output being fed directly to the phones, it is passed through an audio transformer and fed to the base of an NPN bipolar transistor acting as an audio amplifer.

The amplified signals appearing in its collector circuit are then applied to the phones. Because of the extra amplification or gain, weak signals can be heard with less effort. Furthermore, the reaction control may not have to be set so critically to obtain adequate sound level, making operation and adjustment of the receiver that much easier.

The use of audio inter-stage transformers as shown in figures 1, 2 and 5 was commonplace many years ago mainly because of the step-up they could give in the signal voltage. This supplemented, very usefully, the rather limited gain that was available from early valves.

As a component, however, audio transformers have always been rather bulky and expensive, prone to breakdown and liable to introduce distortion of one type or another. As a result, the growing tendency through the years has been to avoid them by using alternative coupling methods. One such method is resistor-capacitor or R-C coupling, which is illustrated in figure 6.

A resistor Rd, normally called the drain load resistor, is connected between the FET drain and the battery in place of the audio transformer primary winding. With no input signal, a certain drain current flows through this resistor and produces a corresponding voltage drop across it. The actual voltage at the drain of the FET is thus somewhat less than the battery voltage.

The base of the following audio amplifier transistor is fed with its appropriate bias as before, but not in this case by means of a separate battery as in figure 5. It is necessary to supply the bias from a source having a reasonably high impedance, and although this can be done in a variety of ways, the method shown in figure 6 is that most often used with bipolar transistors. Here the bias is derived from the main drain-collector supply battery using a voltage divider formed by resistors Ra and Rb. The relative value of the resistors determines the proportion of the battery voltage applied to the transistor, so that the bias is adjusted by altering the resistor values.

Between the FET drain and the transistor base is the coupling capacitor, Cc. Since the capacitor is connected between the drain, a point in the circuit at relatively high voltage, and the base, a point in the circuit at relatively low voltage, it will initially acquire a charge equal to the voltage difference between the two. And the capacitor is always made large enough with respect to the resistors Rd., Ra and Rb that it cannot alter this charge appreciably at an audio rate.

Now, when an audio component swings the FET drain current up and down, the voltage drop across the drain load resistor varies. As a result, the drain voltage itself varies at an audio rate.

Since the capacitor cannot alter its charge at an audio rate, it simply transfers the variations in voltage to the following base, the variations appearing at the base as an alternating audio signal. The signal is then amplified by the transistor in the ordinary way.

In other words, the coupling capacitor transfers the AC audio signal from the drain to the base, while at the same time preventing the relatively high voltage at the drain from upsetting the somewhat lower bias voltage at the base.

Much more could be said about resistance-capacitance coupling, but the foregoing should convey the general idea. Needless to say the technique is equally suitable for coupling between transistors, FETs and valves, or any combinations of these devices.

Just as the addition of one audio stage to a detector makes for a more sensitive and versatile receiver, so can further improvement be obtained by using two audio stages, with either transformer or resistance-capacitance coupling. In point of fact, many domestic receivers in the early days of radio were designed around a detector and two audio stages.

In such a case the amplification can be of such an order that the use of a loud speaker can be considered, rather than headphones. The convenience of a loud speaker is obvious but it does need to produce a great deal more sound output than phones, if it is to be heard properly.

This raises a special difficulty. If a loudspeaker has to produce a lot more sound output or acoustic power, it has to be supplied with a lot more audio power in the form of electrical energy.

If we can cut a lot of corners to make the point clear, we can say that most loud speakers and, of course, earphones operate by virtue of a changing flow of current through their windings. Therefore a lot of acoustic output requiring a lot of audio electrical power can also be thought of as requiring a large change of current flowing through the windings.

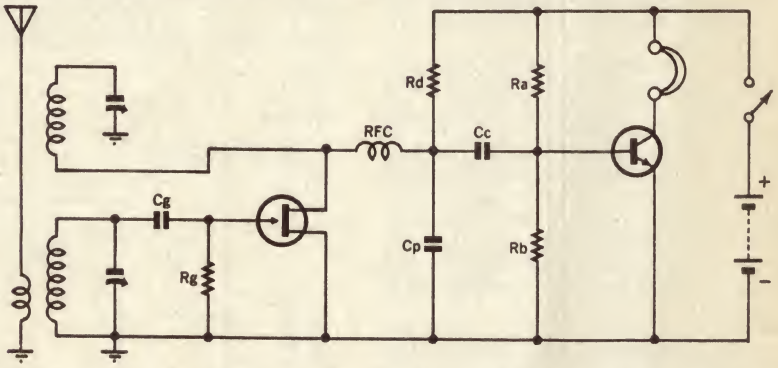


Figure 6: A two-stage receiver similar to that of figure 5, but in this case using resistor-capacitor or "R-C" coupling between the detector and audio amplifier stages. This avoids the relatively costly audio transformer.

Now if a transistor, FET or valve is to amplify without distortion, its output current cannot swing beyond the limits of zero to twice the standing or "no signal" current. Therefore, if the last transistor in a receiver is intended to draw only 1 milliamp of standing collector current, the maximum current change it can effect through phones or a loud speaker is plus and minus 1 milliamp — that is, from zero to 2 milliamps.

Such a change might be plenty for phones but it certainly would not be enough to produce much output from an ordinary loudspeaker. To operate a loudspeaker, therefore, it is necessary to use in the last stage of a receiver a device which can draw a higher standing current. With a signal, the current can then swing through wider limits.

Transistor and valve manufacturers in fact provide devices expressly designed for use as power amplifiers. Such devices are designed to be capable of passing relatively large currents, and dissipating relatively large amounts of power, without damage.

It is beyond the province of this chapter to discuss the many circuit arrangements possible using transistors, FETs and valves, and, from the beginner's point of view, individual designs have to be accepted and constructed on their merits. As knowledge increases, the general ideas conveyed by this chapter will gradually be supplemented by other knowledge.

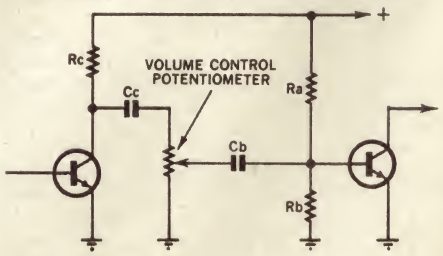


Figure 7: Showing the way in which a potentiometer or "pot" is used as a gain or volume control.

It should however be mentioned that the provision of high gain or amplification in a receiver can introduce the problem of overload. The word is almost self-explanatory.

On weak signals, the amplification available in a receiver may be just enough to raise their level sufficiently to operate the phones or loudspeaker.

If the same amplification is applied to signals which are already fairly strong, they will be amplified so much in, say, the first stage that they are too great for the second stage to handle. As a result, the stage overloads and produces a very distorted output signal — sounding rough and harsh to the ears.

To avoid this difficulty, it is often necessary to include in a receiver some means of varying the amplification. To use another phrase, some method of volume control or gain control must be included.

A certain amount of gain or volume control effect can be obtained by varying the setting of the reaction control. The more nearly this control approaches the position for oscillation, the louder will the signals become, and vice versa.

The big difficulty with this method is that the setting of the reaction control also affects selectivity and it may easily happen that a position which gives adequate signal level may not give enough selectivity to select the wanted from the unwanted signals.

Ideally, the reaction control should be operable for best detector performance, with an entirely separate control for gain.

Over the years many methods of gain control have been devised, including in valve circuits the variation in filament voltage with a rheostat, variation in plate voltage or grid bias or variation of screen voltage in a pentode or tetrode. All of these schemes are open to criticism because, in reducing gain, they also limit the valve's ability to handle strong signals, thereby introducing distortion in many cases.

Nowadays the method almost universally adopted in audio circuits using any of the normal amplifying devices — transistors, FETs or valves — is that illustrated in figure 7. A potentiometer is connected between the output of one stage and the input of the next in such a fashion that it may be used to adjust the proportion of output coupled between the two.

The audio AC developed across the load resistor Rc is fed by the coupling capacitor Cc across the whole of the potentiometer. The position of the moving arm of the potentiometer then determines the proportion of this AC voltage which is coupled through the second capacitor Cb into the following base. Thus moving the arm of the potentiometer up and down the resistance element varies the volume of sound heard in the phones or loudspeaker, and allows the volume to be adjusted to a convenient level.

In designing a radio receiver or audio amplifier, it is usual to connect the volume or gain control ahead of the first stage in the circuit which is likely to be overloaded in the event of a strong input signal. In simple radio receivers of the type which we have looked at in this chapter, the control would generally be connected between the detector stage and the first audio amplifier.

In the next chapter we will progress to look at more complex radio receivers.

Elementary Electronics

Light beam relay

Light beam relay systems have always intrigued our younger readers, and the present generation is no exception. Whether you use it for a serious alarm system, or just for fun or a novelty, you will find it an intriguing project.

by ROSS TESTER

A common request from readers is for a device which will detect intruders as they enter a driveway. The need for such a device appears to be increasing as, seemingly, undesirable types are becoming more daring and more numerous. It is quite common these days to hear of cars being stolen from inside a person's property.

Our light beam relay would go at least part of the way to prevent this. If it is placed across the entrance to a driveway, an intruder will have to cross it in order to reach the car. And by the time he has unlocked it, the owner should have been able to summon assistance.

In the January "Elementary Electronics" we published a series of one transistor circuits which included a simple burglar alarm. Using the same basic circuit we can make a light beam relay system; a device which has many possible uses. It may form part of a burglar alarm system itself, may serve as a shop minder, or as the basis for many novelty displays.

In the burglar alarm, we described how door and window switches could be used to hold a transistor in the off mode by removing the forward bias from the base. This system works much the same, except that we have replaced the switches with a light dependant resistor, or LDR. A beam of light aimed at the LDR from an incandescent globe provides control.

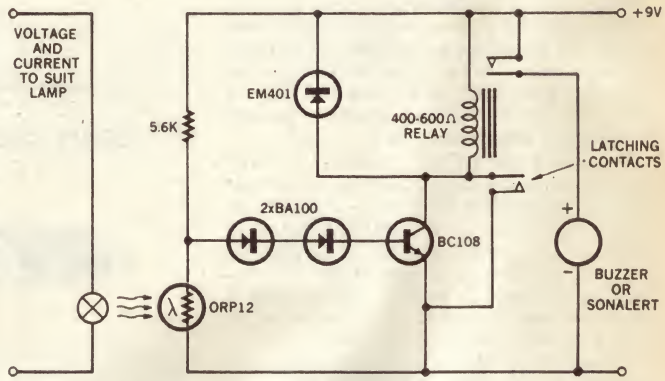
Briefly, an LDR works as follows: In its normal (dark) state, the cadmium sulphide (CdS) of which the LDR is made can be regarded as a normal semiconductor. That is, most of the electrons of the atoms are situated in the "valence" bands and are not free to move around for conduction. So the LDR exhibits a high resistance, typically around 10 megohms.

When light strikes the LDR, the electrons are excited, and some of them are raised from the valence band into a conduction band where they are available for conduction. Hence, the resistance lowers. The stronger the light, the more excited the electrons become, and the greater the number available in the conduction band. Hence the resistance lowers still further. The minimum resistance obtainable depends on the particular LDR, but ranges from approximately 75 ohms up to 300 ohms.

If you found the previous explanation rather heavy going, do not worry. Just remember that in darkness, the resistance of the LDR is very high. In bright light, it is quite low.

By placing the LDR between the base and emitter of a transistor, we are able to control the forward bias on the base. When light shines on the LDR, the base of the transistor is almost at the same potential as the emitter (minimum forward bias); because of the very low resistance between them. Therefore the transistor will not conduct. But if a shadow passes across the LDR, (such as that from a person walking in front of it) the resistance of the LDR rises, and the base voltage is raised. This biases the transistor on, and current flows from emitter to collector, through the relay, closing its contacts.

The transistor would be turned on only for the time the shadow is across the LDR. If this light beam relay was used as a shop door minder, or similar application, it would only be necessary to add a buzzer or similar alarm to the relay. Every time someone came into the shop (and interrupted the beam) the buzzer or alarm would be activated briefly.



The circuit is based on the burglar alarm circuit in the January issue. Its operation is most easily understood by visualising the LDR as a substitute for the door and window switches.

However, if you were considering using this device as a burglar or intruder alarm, some sort of latching circuitry would be necessary to keep the alarm functioning. A very short buzz might go unnoticed, particularly if it had to wake someone from sleep.

There are several ways of providing this latching function. For example, a simple R-C circuit to keep the relay closed for a certain time, then drop out; or a "slugged relay" which, in itself, takes a certain time to drop out; or, perhaps, a network to hold the transistor base biased for a fixed time regardless of the resistance of the LDR.

However, we elected to take the simple way out. We simply wired in an extra set of contacts on the relay to bypass the transistor, and therefore hold the relay on until it was turned off manually. This method does create the inconvenience of having to turn it off, but it has two advantages; the alarm must be investigated (it cannot be ignored) and, perhaps more importantly, it does not add to the cost.

There are other uses to which the light beam relay may be put, but we will leave them to the ingenuity of the individual. We might warn you, however, that if you are not used to dealing with mains circuitry, it is best to leave it alone.

The light beam itself may come from many sources. For simplicity, we first used a small incandescent torch globe, but found that the range was rather limited.

We then tried various other light sources, and eventually settled on a 6 volt car tail or brake light as being the best. These have two major advantages — there are many variations in wattage available, from three to 24 or so, and the filament is quite small.

The smaller our source of light, the closer we can come to producing a parallel beam, with the aid of a lens, and make most use of the available light.

One disadvantage of the higher current lamps is that they dissipate a lot of heat. This means that they must be adequately ventilated however they are housed. If you follow our later suggestion to house them in cardboard tubes, we suggest that the back of the tube be left open with perhaps a few holes drilled between the lamp and the lens.

Mounting the brake light should be no problem. Any automotive wrecking yard would be able to supply a brake light holder from a wrecked car — in all probability with the brake light still inside.

If you use such a light, it is more than probable that you will require a transformer to run it. The light would draw too much current to make battery use feasible. The transformer must be able to supply the required current on a continuous basis. The current drawn by the lamp can be worked out by Ohm's law from the marked wattage rating.

The transformer must have a rating of at least 3 amps to run an 18 watt, 6 volt bulb continuously. Transformers which fall into this category include the Ferguson PF162, PF476 and the A&R 5508. The A&R has a maximum current rating of 4 amps, so would suit lamps up to 24 watts.

If an automotive globe has a nominal 6V rating it is quite in order to use it with a 6.3V transformer. These lamps are designed for use in electrical systems where the voltage may rise to 7.5V, or even higher in some circumstances.

If you are contemplating only a short distance of operation, a brake light is not really necessary. We were able to make a six volt, 300mA globe operate the relay from across our laboratory — wider than would be necessary for protection of one door. The brake light would operate the relay over a much greater distance. It is possible to arrange a system of mirrors which will allow complete protection of a doorway. All that is necessary is to set the mirrors so that a beam of light is reflected back and forth across the doorway, with the LDR at the top and the lamp at the bottom. In other words, if any part of the beam is broken, even by something very small going through the doorway, the LDR will react and the relay operate.

By using suitable optical systems, we can make this light beam really operate over quite long distances.

The performance of the LDR can be greatly improved by the use of a lens. A lens, placed at the correct focal point, will focus the light onto the area of the LDR which contains the light sensing CdS cell. This means that the cell presents a much larger capture area to the available light.

If a lens is also associated with the lamp, results will be even better. In theory a lens should be able to produce a parallel beam of light from the light source, assuming a perfect point source. Since we cannot provide a point source we will actually create a slightly diverging beam, but this is still a lot better than no beam at all.

The lenses we used were purchased from one of our advertisers, Deitch Bros, of 70 Oxford St, Sydney. They are 1½ inch diameter, with a focal length of about two inches. They are priced at fifty cents each. Larger lenses (2½ inch dia) are available for $1.50, or $2.50 per pair. These lenses should do an even better job.

Another point worth considering is that the beam can be made quite invisible until the intruder is actually in its path — by which time he has triggered the alarm. By recessing the light and lens into a long, thin tube which is painted a matte black on the inside, it becomes almost impossible to detect the light coming from the tube unless you were looking directly at it.

A method of making the light even harder to detect is to use infra-red filters over the light source. This will reduce the light output somewhat, but it will still be adequate for many applications. Infra-red filters are available from photographic suppliers and are not unduly expensive. This subject was dealt with in detail in an article, "Invisible Light Beam Relay Systems", February 1963 (File No 2/LR/4). Copies are available for 50c each.

Construction of the light beam relay should not prove difficult. The electronic components, except the LDR, may be placed on a tagstrip using the layout we have shown.

The LDR and lens tube may be made the same way as ours, or some readers may have different ideas. We first made a tube the same size as the lens with cardboard and brown paper, and painted the inside black. Then we made another tube which would slide over the first one. A circle of Veroboard was cut the same size as the larger tube. The LDR was soldered exactly in the middle, and the Veroboard was fixed to the end of the tube with Bostik.

A housing for the LDR and lens can be made from two cardboard tubes. The upper one contains the lens, the lower one the LDR. Note the piece of Veroboard cemented in the end.

The two tubes assembled. The outer one was salvaged from a roll of plastic wrapping, the lower one made to fit.

The long tubes, with their black interior, also help to minimise the amount of ambient light which reaches the LDR. This can otherwise seriously affect the range over which the system will operate.

When the paint on the smaller tube had dried, we forced the lens into it, approximately one inch from the end. All we had to do then was focus the lens onto the centre of the LDR. This was simple — as the LDR changes with light intensity, we just connected a multimeter (on x100 range) to the LDR, pointed the tubes at the window, and slid the inner one in and out until we had maximum deflection of the meter.

The same system may be used for making, and adjusting, the light tubes. To focus the light, point it at the LDR, and adjust the light for maximum reading of the meter.

We did not use a reflector for the lamp, as we considered them to be too expensive for this project. However, if you do obtain one (again, from a wrecking yard) it may be used instead of going to waste. A reflector and lens assembly makes much better use of the available light.

A number of readers have reported difficulty in obtaining a 500 ohm relay which would pull in when used on the original burglar alarm. We imagine that the same problem may occur with this unit.

One Sydney retailer informs us that he has obtained a relay from STC (type AFO) which was able to do the job. Its resistance is 430 ohms, and works quite satisfactorily on a 9 volt supply. In our original unit, we used an ex-disposals relay (obtainable from a computer wrecker). In its original condition it would not pull in, but we removed one of the sets of contacts to lessen the spring tension and found it to be quite satisfactory.

The alarm unit can take a number of forms. The most obvious is the conventional bell or buzzer, and this should be adequate in most cases. Other possibilities are a small audio oscillator and speaker (Signal Oscillator, May 1962, File No 1/MS/4) or the commercially available "Sonalert" made by Mallory. Although the latter is a dearer unit (about six dollars) it produces a very effective note, and offers a high order of reliability, a particularly valuable feature in commercial installations.

So there it is — a simple light beam relay which is economical to build and should be quite reliable in service.

Elementary Electronics

A Brake Light Warning System

We have seen many designs of indicators which warn when a brake light has failed. Most were quite ingenious, but all suffered from the same objection — they were either too expensive or too involved to warrant Mr Average fitting them to the family car. This design should change all that . . .

Most systems we have seen relied on a solid state device sensing the current across a low resistance placed in series with the lights. While this works very well, it involves a lot of messing around with the brake switch wires and the line to the lights themselves.

Other systems use a light sensing device (usually an LDR) to determine whether or not light is coming from the globe when power was applied. This arrangement does alleviate some of the former problems, but introduces new ones of its own, in that wires must be run back to the indicator lamp on the dashboard, and also that the brake light housing may have to be modified to accommodate the LDR.

But our brake light indicator requires only one break in the line — and if your car is typical of the majority these days, you won't even have to cut the wire; there will be a barrel type connector available at a convenient point for the circuit to be intercepted.

Another advantage of our indicator is that it works equally well on either polarity electrical system, with no changes necessary.

But the biggest advantage of all us is that it should cost well under two dollars to build.

Unfortunately, we cannot claim this as an original idea. It was suggested by a contributor to "The Radio Constructor" (September 1971) and appealed to us so much for its simplicity and inherent reliability that we felt we must pass it on to our readers. Accordingly, we built our own version, tried it out, and prepared this article.

The heart of our system is a dry reed switch. The one used, the XS7, is an economy type which retails somewhere around seventy cents.

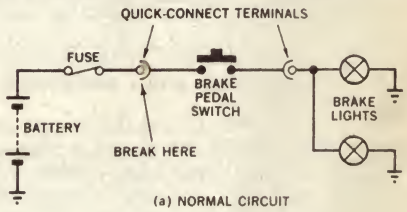
This, and the price of an indicator bezel, is the only real cost. The other parts, a few inches of wire and a couple of tagstrips, can probably come from the junk box. Even if you have to buy them, they won't cost more than a few cents.

Briefly, the construction and operation of our indicator is as follows. Wound around the reed switch is a coil of wire. This wire is connected in series with the wire from the brake pedal switch to the brake lights. One end of the reed switch connects to this same line, the other end connects to the indicator lamp, and the other side of the indicator lamp cannects to chassis.

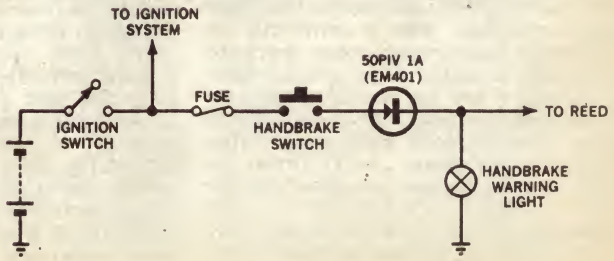
When the pedal is pressed, the brake light switch is turned on. Current flows through the brake lights via the coil. When current flows in the coil it becomes an electromagnet. If the magnetic field is strong enough the contacts of the reed switch will close, allowing the bezel lamp to light. When the brake is released, the whole system returns to normal. Thus, every time the brake pedal is operated the driver is given a visible indication that the brake lights are working.

On the other hand, if there is no current, or insufficient current, the reed will not close and the indicator lamp will not light. This warns the driver that there is a fault somewhere in the brake light system.

From this simple description it will be realised that the system is almost completely "fail safe". Regardless of what can go wrong, from a burnt out indicator lamp



Right: At (a) is a normal brake light circuit. At (b) as modified to include the warning light. Below: Construction of the finished unit.



How the system may be wired to allow the handbrake warning light to double as a brake light failure indicator.

A typical installation. When the brake pedal is depressed the indicator light comes on.

to welded contacts in the reed switch (a most unlikely situation anyway), the result will always be to draw the driver's attention to it. And having done that, it has served its purpose.

A major requirement which this system must satisfy is that it will indicate the failure of only one lamp in the normal two lamp brake light system. This is not hard to do, and a few simple facts about the reed and the lighting system will make it easy to understand.

There are two strengths of magnetic field needed to operate a reed switch. One is the "operating" field, needed to close the contacts, and the other is the "holding" field, needed to hold them together. The operating field needs to be — typically — about three and a half times stronger than the holding field.

When a lamp is cold, its filament resistance is much lower than when it is hot; typically the cold resistance would be only about one eighth of its hot resistance. This means that, at the moment of switch-on, the lamp will draw, for a brief instant, about eight times its normal running current.

We make good use of these two facts. They enable us to adjust the sensitivity of the system so that the reed will just hold in reliably on the current needed to operate two lamps. If one lamp should fail, there will not be enough current to hold the reed in.

In this regard we are fortunate that the cold surge of the lamps is so much greater than their running current. Otherwise we could not adjust the system for such a critical value of holding current and still ensure that the reed would pull in reliably. As it is, the reed will pull in reliably on the surge current from only a single lamp, but it will not hold in, resulting in only a brief flicker.

In practice, this simply means winding the correct number of turns around the reed switch. This isn't hard, even if your brake light system is not the same as the one we used. In our case we took an educated guess and tried 12 turns, which turned out to be spot on. We did try adding and subtracting

(Continued on Page 125)

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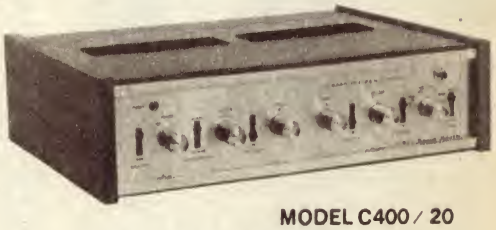

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Reviewed by Julian Russell

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SCHUMANN — Piano Concerto in A Minor. Svjatoslav Richter with the National Philharmonic Orchestra of Warsaw conducted by Witold Rowicki. Cello Concerto in A minor. Mstislav Rostropovitch with the Leningrad Philharmonic Orchestra conducted by Gennadi Rozhdestwensky. DGG Stereo 923107.

Like most DGG records and cassettes the engineering slightly favours the soloist in the piano concerto especially in the mezzo-forte passages. Apart from that the sound is good with very little background noise and very faithful piano tone. The first movement, despite the brisk tempo, sounds really romantic particularly where the speed slows down to introduce a mood of poetic musings. Some may find this contrast a little too great for their taste though, to me, the treatment seems somehow to increase the work's stature. The result is very different from the usual almost chamber-music-like atmosphere it engenders. In fact there are moments when the first movement sounds quite turbulent. The orchestra is far from being out of the top drawer.

The second movement is always beautifully lyrical and in this the orchestra is consistently in better balance with the pianist. I was grateful for this because it would have been a pity to have to strain to hear the lovely cello theme in the middle section. The Finale is stylish and full of refined vitality. But it might take a couple of repetitions to adjust to the highly individual treatment of the first movement.

This is easily the best recording Rostropovitch has made of the Cello Concerto. His others have been disappointing for a variety of reasons. Here he is in very top form with splendid orchestral support. He approaches the work like a lover, caressing every note but drooling over none. Yet all is expressed over the very firmest of foundations. The orchestra is in every way worthy of the honour of teaming with such a great artist. In every way the very vest performance of the concerto I know and I recommend it with the greatest enthusiasm.

★ ★ ★

SAINT-SAENS - Piano Concerto No. 4 in C Minor.

LISZT — Totentanz for Piano and Orchestra. Hungarian Fantasy for Piano and Orchestra. Michele Campanella and the Monte Carlo Opera Orchestra conducted by Aldo Ceccato. Philips Stereo 7300 074.

This Saint-Saens concerto has no claim to profundity, but it is consistently mellifluous and of immaculate workmanship. Neither the conductor nor the soloist is known to me, though Ceccato's name appears twice in the English Gramophone Classical Record Catalogue. Campanella has a smooth technique and a romantic style admirably suited to the often showy nature of the concerto. In these virtues he is well matched by the well balanced Monte Carlo players. The work is in two movements but the second is in three sections, the two outer ones linked by a scherzo so that the form is not as unusual as it might appear from a bald description. The scherzo is distinguished by some exhilaratingly rhythmic playing of material not far removed from the commonplace.

Nor do the other two sections contain much that is musically notable. Moreover the piano writing shows only little technical originality. It is a minor, a very minor, work but easy to listen to and certainly very well presented. I'd say that it would be more popular in France than anywhere else.

Liszt's Totentanz consists of 30 variations on the theme of the plainsong "Dies Irae" and is much more inventive than the Saint-Saens work. After a doom-laden statement of the theme it goes on to some typical Lisztian fireworks. You will hear many changes of harmony, rhythm and mood and lavish introduction of counter-themes. Campanella plays it all with fine brio interrupted by sensitive expression in the more meditative sections. A variation with quickly repeated notes comes off very brilliantly indeed — a demanding test for any pianist's technique.

The orchestra enters enthusiastically into the spirit of the soloist's performance though its sometimes plummy sound would make a trifle more incisive engineering a welcome addition. However the piano tone is faithful and Campanella's style is rather like Cziffra's, but without that pianist's all too frequent vulgarities. It says much for Liszt's resources that one doesn't tire of the short theme, despite its many repetitions. The Hungarian Fantasy is also played with elan by both pianist and orchestra. I can recommend this cassette to all those who like their music showy — though I do not use this word in its pejorative sense — and easy to listen to at first hearing.

★ ★ ★

MOZART — Symphony No. 35 in D, K. 408 (Haffner). Symphony No. 40 in G Minor. March K408, No. 2. Academy of St. Martin in the Fields Orchestra conducted by Neville Marriner. Philips Stereo 7300 086.

In the Haffner the orchestra is a little too woolly and prominent in the bass until a hefty treble boost adjusts things so that it sounds very good indeed without any hint of its small dimensions even for a chamber group. This is more noticeable, however, in the G minor, a work on a larger scale altogether. In both symphonies the playing is always alert, beautifully phrased and has about it a sprightliness reminiscent of Beecham on one of his best days. In the Haffner, for instance, the contrast between the first and second subjects of the first movement is very subtle indeed. Altogether it might well be described as an admirable performance of a seraphic work.

Marriner uses the original scoring of the G Minor — without clarinets. These are nearly always used in present day performances of the symphony, some claiming that Mozart himself added them in a later revision although this is by no means certain. Despite their absence here the score is full of the most enchanting detail. It has a transparency and limpidity that I find altogether bewitching. I enjoyed enormously the thrusting urgency of the first movement's first subject though I did think the horns a trifle too thick-toned in the menuetto. But play this symphony as often as you like you'll hear something new—and ravishing — every time. Strongly recommended, after the adjustment mentioned above is made — at any rate on my equipment.

I almost forgot to mention the little march that fills the first side. It is a piece of what I always think of as tongue-in-cheek pompousness played here with beguiling innocence.

★ ★ ★

BRAHMS — Concerto for Violin and Cello in A Minor. Wolfgang Schneiderhahn (violin) and Janos Starker (cello) with the Berlin Radio Symphony Orchestra conducted by Ferenc Fricsay. Tragic Overture. Berlin Philharmonic Orchestra conducted by Lorin Maazel. DGG Stereo 923 028.

You'll need a good deal of gain to get the best out of this cassette. But even then the orchestral tone is a little woolly and detail occasionally disappears. There are some, however, who approve of this as true Brahmsian sound, mostly Central European musicians. But in England some suppression of inner voices is preferred to achieve a more transparent quality. But whatever your preferences in tonal values there is no gainsaying the truly Brahmsian style and mood of the playing here. Technically the collaboration between the two soloists is superb. Whenever the melodic line, or figuration, passes from one instrument to the other it does so without any hint of a seam. There is, however, a wide temperamental difference between Scheiderhahn and Starker though neither can be described as a ball of fire emotionally. Starker does seem at times to entice Schneiderhahn out of his cool shell though it is at these moments that the latter doesn't sound quite at ease. Despite what I've written this is not a performance to be ignored and if you're looking for the work in cassette form I know of none better on the market.

Maazel tends to make the Brahms Overture sound more melodramatic than tragic. You will notice that there is a change of orchestra as well as conductor in the second work, which has more background noise than is thought permissible in these

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days of improved cassette recording. Now and again Maazel uses a relentless drive that, to me, seems alien to Brahms. But despite the noise mentioned above the acoustic is much cleaner than in the concerto with an occasional quiet passage sounding even dainty. However to enjoy the performance you must accustom yourself to unusually violent changes of tempo and dynamics.

★ ★ ★

TCHAIKOVSKY — Piano Concertos Nos. 1 in B Flat Minor and 3 in E Flat (Unfinished). Werner Haas with the Monte Carlo Opera Orchestra conducted by Eliahu Inbal. Philips Stereo 7300 082

The piano tone is a little edgy and there is a trace of wow. The recording is so forward that I found it necessary to turn the volume control way down. Orchestra and soloist attack the first movement without any messing about. (This concerto is popular with pianists because the hammered-out first chords give them plenty of confidence.) Both band and pianist go all out for effect — and nearly always achieve it. Their presentation of the work is full of violent contrasts never out of place in this concerto. It is all a trifle too showy for my taste though it should appeal to all those who like to enjoy a good wallow.

The piano tone apart, the engineering is vivid in the loud passages and silky in the softer ones. For those who admire a reading with all stops full out this should be a delight. It should also please admirers of the Ken Russel film which offered similar accounts of Tchaikovsky's works to accompany a lurid tale about his sexual life. The balance between piano and orchestra is excellent and the conductor enters enthusiastically into the spirit of the soloist's reading. The performance has a lot going for it, if that's the way you like it. In the second movement it is a pity that the piano's figurations cover the charming little nursery tune that appears briefly towards the middle. But as one may have guessed this movement provides a welcome point of repose between the two outer movements. The Finale is brilliantly rhythmic and in it the conductor introduces a few lyrical bars but is soon unceremoniously urged back into his soloist's prevailing mood of emotional intensity.

The E Flat Concerto is seldom heard either on disc or in the concert hall, though it was one of Tchaikovsky's last works. It is based on drafts of a symphony which he discarded and which have since been lost. It is in a single movement and some doubts exist as to whether he intended it as a one movement work or the first movement of a conventional three movement concerto. Taking the latter case for granted a pupil, Taniev, added two more movements. The version recorded here is as the composer left it.

The scoring of the first tutti is very thick, an unusual feature in Tchaikovsky's orchestration. The movement is full of vigour and mature, discerning use of not very notable material. Its main interest is in its unfamiliarity though it has a few very rewarding moments. Its prevailing mood is perfervid rather than fervid and the scoring right through suggests that he must have been listening to rather more Brahms than was good for him. Even with this movement as a fill there is still a much longer than usual run off on the second side.

HAYDN — Symphony No. 26 in D Minor. Symphony No. 34 in D Minor. Symphony No. 77 in B Flat. English Chamber Orchestra conducted by Raymond Leppard. Philips Stereo 7300 064.

HAYDN — Symphony No. 52 in C Minor. Symphony No. 53 in D (L'Imperiale). Academy of St. Martin in the Fields Orchestra conducted by Neville Marriner. Philips Stereo 7300 084.

The playing of these two different chamber orchestras and conductors is of such perfection that it leaves little for me to write but words of unstinted praise — something that is always a bore to read. It is much easier to write about an indifferent or downright bad performance. The cassette sound is really first rate. The conductors have different temperaments, and speaking in a very general way, Leppard is a tiny bit more vigorous in his interpretations than Marriner. Yet both sound indubitably correct. They share the same respect for the composer, the same sense of period style and each orchestra's contribution is beyond praise.

For the rest I can only say that they should provide unflagging delight to all who appreciate Haydn's inexhaustible invention, his simple yet wonderful scoring and the perfect proportions of his form. I can only urge you not only to acquire these two cassettes but to keep your eyes open for any that might follow. I see no reason why they shouldn't be of the same extraordinarily high standard of performance and engineering.

★ ★ ★

WEBER — Clarinet Concerto No. 1 in F Minor. Clarinet Concerto No. 2 in E Flat. Oskar Michallik and the Dresden State Orchestra conducted by Kurt Sanderling. Philips Stereo 18459 CAB.

I am afraid I cannot express much enthusiasm for these two elegant compositions. At the beginning of the F Minor the solo clarinet's tone is a little too sharp-edged to appeal to me, though it always remains nice and reedy and is very full in the low chalumeau register. This rather coarse attack might well be attributed to the soloist's nervousness, since he improves later and becomes much more refined. But the performances of both works are seldom exciting, and the orchestra, certainly not out of the top drawer, tends to plod along metronomically. The general effect is not to be compared with other fine performances of these two charming works recorded on disc.

On disc . . .

WAGNER — The Mastersingers of Nuremberg. Complete opera. Otto Weiner (Hans Sachs); Hans Hotter (Pogner); Benno Kusche (Beckmesser); Jess Thomas (Walter); Friedrich Lenz (David); Claire Watson (Eva); Lillian Benningsen (Magdalena); the Chorus of the Bavarian State Opera; the Bavarian State Orchestra conducted by Joseph Keilberth. World Record Club Stereo S 4712-3-4-5-6.

I found this set very disappointing for several reasons. It was recorded live at a dress rehearsal for a performance

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organised to celebrate the reopening of Munich's rebuilt opera house, badly damaged by bombs during the war. It has the customary faults of live recording of operas — audience noises, coughs and feet shifting, and footsteps tramping across the stage. You can even hear the curtain coming down on the quiet ending of Act 2. There is one curious anomaly. According to the English / German libretto that accompanies the boxed set, Pogner is sung by Gottlob Frick. The record labels, however, put Hans Hotter in the part. I heard both these singers in Germany in 1962, a year only before this set was recorded, and will stake what little reputation I have that it is Hotter in the part. His voice has the characteristic woolliness lamentably in evidence during that period and quite unlike the sharply focused dark tone produced by Frick.

In the January 1964 issue of the English magazine "Opera", Harold Rosenthal, in his description of the dress rehearsal puts this down to Hotter having sung while suffering from a cold. But I am afraid that whenever I heard him it sounded the same and in Vienna in 1965 when I heard him in Don Carlos this woolliness had increased to an extent that made it difficult to be sure of what note he was singing. It must be faced that the voice of this formerly great singer was already "sur le retour" as the French say, though in the set under review he is still able to give a noble, dignified characterisation of the role.

Jess Thomas sounds better in this recording than he did when I heard him in the part in Vienna in 1965. One misses on disc the tendency to brashness in his live performance. He may perhaps have been off-colour on the night I heard him, though he seemed quite comfortable getting through a useful supper at Sacher's after the show that night. He certainly has moments of refinement that I missed in Vienna. And there he had Josef Krips and the Vienna Philharmonic to support him. Beckmesser (Benno Kusche) is altogether too vague and uncertain in character to carry conviction in this performance; though I liked Friedrich Lenz's account of David, despite a tendency to sound older than he should in this role. Otto Wiener's Sachs sounds more like a blueprint of the role rather than a flesh and blood man of subtle moods.

Of the two women, Claire Watson is suitably warm and delicately flirtatious as Eva, but Lillian Benningsen (Magdalena) is a disaster, her wide wobble at times being downright embarrassing to listen to. Keilberth's conducting of the brilliant score I can only describe as pedestrian, in no way comparable to Kempe's in the previous Mastersinger set put out by the World Record Club many years ago. Although this set was issued only in mono you can hear much more detail than in the stereo version under review, and on comparison I found the sound wearing amazingly well. Mono or not I think it in very many ways much preferable to this later issue.

★ ★ ★

STRAUSS (Richard) — Don Juan. Till Eulenspiegel. Tod und Verklarung. Vienna Philharmonic Orchestra conducted by Wilhelm Furtwangler. World Record Club Mono WRC3135.

This mono was recorded by HMV — the date is not mentioned in the sleeve notes — and issued first in 1958, four years after Furtwangler's death. A "new" issue was made in 1968 and the present disc was remastered for World Record Club last year. All things considered, the sound is surprisingly good and delivers quite an astonishing amount of orchestral detail. Furtwangler's Till Eulenspiegel oscillates between the staid, the jaunty and the poetic. But it is seldom lighthearted, or perhaps freakish enough to suggest the mischief claimed in the tone poem's title. To follow it with a score is to realise how very often the conductor ignores the composer's markings and some of his tempos are slow even by Central European standards of deliberate pacing.

Furtwangler takes the wonderful opening bars of Don Juan with some gusto, but it is not the flaming energy of a reckless man. There is a conservation rather than an expenditure of energy. The excellent but anonymous sleeve notes point out that as Furtwangler grew older his tempos became uniformly slower, and if you want a convincing example of this charge, play the long oboe solo in the middle. I have never heard it taken so slowly.

Furtwangler opens Tod und Verklarung with a true death-chamber atmosphere. Here you have genuine exhaustion following a fruitless struggle against agony. The more feverish passages that follow become frenzied in their death spasms and the conductor makes no attempts to tone down the occasional vulgarities. He does, though, introduce some refinement into the commonplace transfiguration theme and presents it with a rare dignity.

Furtwangler might well be considered the last of the great German romantic conductors, whose style a later generation might find it difficult to approve. And even older listeners might find the conductor's readings a little too wilful for their probably changed tastes. But the record's historic interest should ensure good sales, especially when the excellence of the refurbished engineering is considered.

★ ★ ★

BORODIN — String Quartet No. 2 in D Major. Da Sallo String Quartet. Oryx Stereo EXP 50.

The sleeve note states that this quartet was "recorded without microphones" and hails the process as a breakthrough in recording technique. Most of the time I found the sound positively nasty. You hear a very curious mixture of realistic violin tone and almost unbearable coarseness in the lower strings. Balance between the players is non-existent, as is the customary rapport you expect to find among well rehearsed quartet players. It was made — again referring to the sleeve — by "the coupling of vibration sensors to each instrument to capture the presence of the original sound with unmatched fidelity". Matched fidelity would have been much more welcome. If the new system produced sounds as bad as this from only four instruments the prospect of a large orchestra similarly set up for recording is too horrible to think about.

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REVIEWS OF OTHER RECORDINGS

Devotional Recordings and Classical Organ

FESTIVE ORGAN OF THE BAROQUE. David Rumsey, organist. Stereo, Davan LCDS-1001. (From Davan Recordings, 21 Ruthven Av, Magill, SA 5072)

This Australian recording was made in the War Memorial Chapel of Knox Grammar School, Sydney. Installed in the Chapel is an organ which has been the subject of much favourable comment, built by Ronald Sharp of Mortdale, NSW. Using a mechanical action, it employs classical voicing eminently suited to the music in the recital. The sound is brilliant and clean without ever becoming strident. Nor is there any hint of the acoustic muddiness which often mars the sound of large organs in large auditoria.

Organist David Rumsey is Sydney born, but with a wealth of training and experience both in Australia and overseas. His performance here can only be described as impeccable.

On side 1 is "Concerto in G major" and "Pastorale in F major", both by Bach. On side 2 are 6 tracks from the music of Buxtehude, all carrying lengthy titles in German and rather too demanding on space to reproduce here. However, the background to the music is given on the jacket, along with biographical notes on the organist and specifications of the instrument.

I gather that this record was released some time ago but that is not in any sense a disadvantage. For those who like classical organ music, it is well worth a hearing. Equally, it would be a good reference record for those who tend to listen predominantly to electronic organs and to the playing techniques which they foster.

Have a listen and you'll see what I mean. (W.N.W.)

★ ★ ★

GODSPELL. Music and Lyrics by Stephen Schwartz. Stereo, Bell Records (EMI) SBLL-1102.

Here's another recording that will have to be assessed on an individual basis: Is it devotional in any degree or is it purely commercial entertainment which happens to have a religious theme?

It is supposed to be based on the Gospel according to St Matthew but, with no script available and relying only on a record in which diction is not a strong point, the derivation of Godspell has to be taken on trust at this stage.

Reviews of the original production (of which this is a recording) reflect a good deal of enthusiasm but all from the viewpoint of a musical and a spectacle. One would assume that an original-cast recording will find an appropriate number of takers from those who may have seen and enjoyed the actual performance.

However, considered in isolation, the record has a quasi-religious name, a claimed affinity with St Matthew and track titles with protest leanings. The music overall is soft rock but elements of juvenile, revival, soft-shoe, vaudeville and Afro-Asian make their appearance, presumably in accordance with the stage action.

Good theatre . . . maybe! Religious . . . by definition! Do-goodish . . . yes! Devotional . . . not as I understand the term! (W.N.W.)

★ ★ ★

DID YOU THINK TO PRAY. Charlie Pride. Stereo, RCA LSP-4513.

Recorded at the RCA Nashville Studios, and with backing by the well known Jordonaires, this album of Gospel songs by the negro artist Charlie Pride has a strong country and western flavour. It is evident in the lyrics, the arrangements and the vocal mannerisms of the soloist. The titles:

Did You Think To Pray? — I'll Fly Away — Time Out For Jesus — Angel Band — Jesus, Don't Give Up On Me — Let Me Live — Whispering Hope — The Highway Leads To Glory — The Church In The Wildwood — Lord, Build Me A Cabin In Glory.

If you are partial to the C&W style, you can buy with confidence. Diction is good and the quality well up to standard. (W.N.W.)

★ ★ ★

YOUNG PERSON'S GUIDE TO THE BIBLE. Scripture readings by James Condon, with musical background. Mono, Columbia OEX-9542.

From the title of this album one might assume that the presentation has been expecially slanted, in some way, to appeal to children. In fact, it is a perfectly straightforward reading of excerpts from the Revised Standard Version of the Bible.

Six tracks on side 1 are all excerpts from Genesis: Creation — Adam And Eve — The Fall — Cain and Abel — The Flood — Tower of Babel. On side 2 five readings from the Gospels cover: Entry into Jerusalem — Anointing at Bethany — Last Supper — The Passion — The Resurrection.

The reading by James Condon, against a gentle musical background is highly professional, not significantly dramatised, with slight but effective changes in inflection between the pure narration and the words spoken by the participants.

If you have a place in your collection for a Bible reading, you can buy this one with confidence — for $2.59. (W.N.W.)

Instrumental, Vocal and Humour . . .

PIANO CONCERTOS No 21 in C (Elvira Madigan Music) and No 22 in E Flat (Mozart). Annie Fischer, piano, with the Philharmonia Orchestra, conducted by Wolfgang Sawallisch. Columbia (EMI) stereo SOEX. 9408.

This disc is reviewed here rather than in the classical section because the title of the Concerto No 21 in C is qualified by the subtitle "Elvira Madigan Music". Presumably it is aimed at those who liked what they heard of its slow movement during the film. Well, if you did like it, and wish to know what the rest of the concerto is like, this disc will cost you only $2.75, and you also get the cheerful Concerto No 22 in E flat, which is undoubtedly a superior work all round.

On the other hand, if you could not care less about Elvira Madigan, and merely have an interest in Mozart, you need have no reservations about the quality of this performance — it is definitely one of the best. Annie Fischer has the rare gift of making one forget completely the mechanics of piano playing during a performance, in the manner of the great Artur Schnabel. One is aware only of the music she produces so effortlessly. Different people react differently to the same artist, but for me Annie Fischer is an ideal Mozart player — playing crisply yet making the most of the melodies, appealing to the sentiments, yet not over-sentimentalising.

Although the disc dates originally from 1959, the sound is surprisingly good, with minimal distortion and good dynamic range. If you like Mozart, this is a disc not to be missed, at its low price. (H.A.T.)

★ ★ ★

THE WORLD OF ITALIAN OPERA. Various artists. Decca (EMI) stereo SPA 105.

The sleeve notes tell us that the tracks here have been specially selected by Stelios Galatopoulos, the author of the book "Italian Opera", published by J. M. Dent, the two to be used in conjunction. Apart from this circumstance, this disc is very much like many others of popular operatic arias, containing such perennial favourites as: La Donna e Mobile — One Fine Day — Celeste Aida — Largo al Factotum — Stride la Vampa, and so on. Outstanding among the many fine singers featured is Joan Sutherland, who presents a magnificent display of coloratura singing in excerpts from "Lucia di Lammermoor" and "La Sonnambula". Renata Tebaldi sings appealingly as "Butterfly" and Mario del Monaco is in fine voice in the "Pagliacci"

Reviews in this section by Neville Williams, Harry Tyrer, Gil Wahlquist, Leo Simpson and Ross Tester.

prologue. Carlo Begonzi, Elena Souliotis, Luciano Pavarotti, Frenando Corena and Ettore Bastianini all contribute, with others.

Again, the sound in some tracks is better than in others, but in the best it is excellent, and it is never less than satisfactory. At its low price of $2.75, many will want this disc. (H.A.T.)

★ ★ ★

TWO GUITAR CONCERTOS, Joaquin Rodrigo. Regino Sainz de la Maza, guitar, with the Manuel de Falla Orchestra, conducted by Cristobal Halffter. RCA Victrola, stereo VICS 1322.

The reissue of this recording provides an opportunity to acquire a definitive performance of what are possibly the two most popular works for guitar and orchestra — Rodrigo's Concierto de Aranjuez, and Fantasia para un Gentilhombre — for the small sum of $2.55. The soloist in both is Regino Sainz de la Maza, to whom the concerto is dedicated, and who was the soloist in its premiere performance in 1940. This performance presumably dates from the early 1960s, so that the sound is of quite acceptable standard.

Nobody would claim that the Manuel de Falla orchestra compares with the world's best, but they are not called upon to do anything spectacular in either work, so that they are not overextended. The spotlight is very definitely on the soloist, and the performer here is the complete master of his instrument. Definitely recommended. (H.A.T.)

TEN FAMOUS TENORS, TEN FAMOUS ARIAS. Decca (EMI) stereo SXLA 7515.

Here is a companion disc to "Ten Famous Sopranos, Ten Famous Arias", reviewed in these columns recently. Like its predecessor, this has some of the top names of modern opera, and some of the best known arias. The singers include Mario del Monaco, Giuseppe di Stefano, Carlo Bergonzi, Jussi Bjoerling and Franco Corelli; and the arias include Vesti la Giubba from Il Pagliacci — Flower Song from "Carmen" — Che Gelida Manina from "La Boheme" — La Donna e Mobile from "Rigoletto" — Celeste Aida from "Aida" — E Lucevan le Stelle from "Tosca".

Once again, the selection is heavily slanted towards Italian opera, but it is certainly a most enjoyable selection, and the singing is magnificent. No information is given about the original recordings from which these tracks are selected, but presumably their ages vary considerably, to judge by the variations in sound quality. (H.A.T.)

★ ★ ★

MUSICA ESPANOLA. Narciso Yepes, guitar solos, DGG (Phonogram Recordings Pty Ltd) stereo 2530 159.
RENDEZVOUS WITH NARCISO YEPES. Narciso Yepes, guitar solos. DGG 2538 106.

Narciso Yepes plays a unique ten-stringed guitar of his own design, which enables him to demonstrate a fine fluidity in his performances. His technique is assured, and in listening to him play some of the more difficult pieces in these recitals, one is wondering if he has been endowed with more than the normal number of fingers. Here, then, are two discs of this fine artist, both of which will be an enjoyable listening experience for those with a taste for classical guitar. If you want only one of these, the matter of price has to be taken into account. "Musica Espanola" will cost you over $6, while "Rendezvous" is priced at only $3.98.

Concerning program, one disc is devoted entirely to Spanish music, as the title implies, while the other has a more general range. Here is the full list of titles:

MUSICA ESPANOLA. (By Albeniz) Leyenda, from "Suite Espanola" — Malaguena, Rumores de la Caleta — Serenata, Torre Bermega, from "Piezas Caracteristicas; (By Granados) Spanish Dance No 4 (Villanesca); (By de Falla) El Circulo Magico, and Cancion del Fuego Fatuo, from "El Amor Brujo" — Miller's Dance from "The Three Cornered Hat"; (By Turina) Sonata, op 61 — Fandanguillo op 36.

RENDEZVOUS WITH NARCISO YEPES. Recuerdos de la Alhambra (Tarrega) — Sonata in E minor (D. Scarlatti) — Bourree in E minor (Bach) — Passemeze et Branle de Poictou (Adrien Leroy) — Sarabande in E minor (Bach) — Saltarello (Anon) — Albarado (Tarrega) — Miller's Dance (de Falla) — Dos Canciones Populares Catalanes (Llobet) — Danza No 1 (Ruiz Pipo) — Prelude No 1 (Villa Lobos) — El Abejorro (Emilio Pujol) — Passapie (Salvador Bacarisse) — Romance, "Jeux Interdit" (trad.).

I am afraid space restrictions will not allow any discussion on the pieces listed, but I can assure you that every piece is well worth its inclusion. The recording is of excellent quality in both instances, but both discs had surface blemishes which proved annoying. (H.A.T.).

★ ★ ★

GRANDE VALSE BRILLANTE. The Berlin Philharmonic Orchestra plays a selection of waltzes. DGG stereo 2538 095.

Herbert von Karajan conducts the Berlin Philharmonic flawlessly through this fine collection of waltzes. Side one begins with two waltzes from Delibes' Coppelia ballet and then continues with two from "Les Sylphides", including the popular "Grande Valse Brillante" after which the disc is named. "Valse triste" by Sibelius and the waltz from "Symphonie Fantastique" by Berlioz complete side one.

Side two leads off with the Waltz of the Flowers from Tchaikovsky's Nutcracker Suite. Then follows the waltz from the same composer's "Serenade for Strings". Lastly, is the "Blue Danube" by Johann Strauss. Many readers will buy the disc just for this track as it was this orchestra which played the tune in the space film, "2001". The record quality was like the playing standard — flawless. (L.D.S.).

★ ★ ★

PUCCINI'S GREATEST HITS. RCA Red Seal Stereo LSC-5003.

Anyone wanting a disc of highlights from Puccini's operas would be hard pressed to beat this one. Topliners such as Anna Moffo, Richard Tucker, Leontyne Price and Sherril Milnes give a high standard of performance throughout. And the quality of the

"skinny" RCA Dynaflex pressing is right up to standard.

The list of tracks is as follows: From La Boheme, "In un coupe? O Mimi, tu piu non torni" and "O soave fanciulla"; From Tosca, "Recondita armonia", "Vissi d'arte" and "E lucevan le stelle"; From Gianni Schicchi, "O mio babbino caro"; From Madame Butterfly, Love duet, "Un bel di" and Humming Chorus; From Turandot, "Nessun dorma". (L.D.S.).

★ ★ ★

THIS IS MANUEL. Manuel and his Music of the Mountains. Studio 2 Stereo (EMI) SOEX 9783.

Manuel, with his Music of the Mountains, has gained a lot of friends among the record buying public. His basic style of singing strings with Latin American rhythm finds variation in the addition of different combinations of instruments — mainly guitars, marimbas, harp and exotic percussion, with occasional contributions from a wordless female choir. This sampler of tracks from previously issued discs is excellent value at $2.75, containing as it does 14 titles, comprising evergreens, current hits and Palm Court classics: Honeymoon Song — Intermezzo from "Escape to Happiness" — A Man and a Woman — The Shadow of Your Smile — Waltz from "Serenade for Strings" (Tchaikovsky) — The Wedding Song — I Will Wait for You — Proud Matador — La Golondrina — Spanish Harlem — Somewhere My Love — Autumn Leaves — I Talk to the Trees — Jealousy.

If you have not yet made the acquaintance of Manuel this attractive program makes a very good disc to effect the introduction — it could well lead to a lasting friendship. On the technical side, there is some variation in sound quality, with noticeable distortion in a few tracks, particularly on the strings. However, most of them are up to the usual Studio 2 Stereo standard. (H.A.T.).

★ ★ ★

CARNIVAL. Manuel and his Music of the Mountains. Studio 2 Stereo (EMI) SOEX 9772.

Also available on the $2.75 economy label, this makes a good companion disc to the one reviewed above. There is rather more of the lively Latin American music included, but variety is provided by the remaining tracks. The 13 titles are: Mascara Negra — How Insensitive — Honeymoon Song — Zambezi — Summertime in Venice — La Mer — The White Rose of Athens — Guantanemera — Concierto de Aranjuez, theme from slow movement (Rodrigo) — Mantilla — Angelitos Negros — Come Closer to Me — Mosaic Theme.

This time there are no complaints about sound quality — it is clean and bright all through, with good stereo spread. An imaginative touch is provided by the inclusion of the excerpt from the Rodrigo guitar concerto. If you buy this disc, and like what you hear of this piece, you may be interested in the disc containing the complete concerto reviewed elsewhere in this issue. (H.A.T.).

★ ★ ★

SHE'S A LADY. Franck Pourcel and his Grand Orchestra. Columbia stereo SCXO-7995.

Franck Pourcel's orchestra is often featured on the "easy listening" programs of several Sydney radio stations and

listening to this disc, it is not hard to see why. His orchestra has a large string section and they play "middle-of-the-road" arrangements of many popular songs. As such, it is just right as a background to dining and mellow conversation. The recording quality is good apart from the two inner tracks of side 2 which show signs of "inner-groove" distortion.

There are 14 tracks in all, some listed as follows: She's A Lady — My Sweet Lord — If You Could Read My Mind — For All We Know — To Sir With Love — Love Story — Close To You — I'll Never Fall In Love Again. (L.D.S.).

★ ★ ★

BEECHAM IN REHEARSAL. World Record Club "Retrospect" series. Mono WRC 3141.

With this record we are privileged to listen in on the late Sir Thomas Beecham conducting his orchestra, the London Philharmonic, during rehearsals in London and Paris. Beecham's trenchant wit often had a mordant quality, and he could be cuttingly cruel on occasions. However, here he is all urbane good humour, making quips and making noisy vocal contributions during the orchestra's playing; and during breaks, he relates anecdotes, some of them against himself.

He is found here rehearsing three of Haydn's "Salomon" symphonies, and arias from Mozart's opera "Il Seraglio", where the orchestra is joined by soloists and the Beecham Choral Society. An entertaining disc, if not one which can be called very satisfying musically. If you buy, I imagine you will not play it often, but when you do you will enjoy it. (H.A.T.).

★ ★ ★

SEA SHANTIES. The Roger Wagner Chorale. Capital (EMI) stereo SENC 9843.

One perhaps is entitled to take for granted the high standard of singing exhibited here by the Roger Wagner Chorale in this polished performance. What really calls for special comment is the quality of the voices of the unnamed soloists, particularly the bass baritone featured in "The Wide Missouri" and elsewhere. The titles are largely what one would expect to find in a collection of sea shanties from an American group: Sailing, Sailing — Erie Canal — Fifteen Men on a Dead Man's Chest — Boston Come All-Ye — Rio Grande — A-Roving — The Golden Vanity — The Drummer and the Cook — High Barbaree — The Wide Missouri — Blow the Man Down — Lowlands — Early in the Morning — Haul Away, Joe — Leave Her Johnny, Leave Her — Tom's Gone to Hilo.

A thoroughly enjoyable performance, which has the added attraction of a $2.75 price tag to offset the slight disadvantage of ten-year-old sound. The quality of the sound is reasonable enough, but it lacks the clarity and definition of modern recordings. (H.A.T.).

★ ★ ★

PEOPLE, ONE TO ONE. Hugo Montenegro's Orchestra and Chorus. RCA Victor Stereo LSP-4537.

Hugo Montenegro certainly has talent for obtaining "different" sound from an orchestra, but unlike other experimenters the results he obtains are always melodious. But dynamic. As an example, side one starts off with "El Condor Pasa" with the theme carried along by a bouzouki but

Australian Bird Calls

AUSTRALIAN BIRD CALLS INDEX — Series 1 — Western Australia.

By John N. Hutchinson. 12-inch long-playing record or 1-hour tape cassette.

Exactly twelve months ago, "Electronics Australia" carried an article "How To Record Bird Song" by Norman Robinson. The same Author is a contributor to this index of bird songs compiled by John Hutchinson. The original intention was to release the recording only as a long-playing disc but, in a covering letter, John Hutchinson explains that another article in E.A.: "How Cassette Tapes Are Made" prompted him to have Olims produce a cassette. This, in fact, is what we listened to.

All told, the recording contains the songs of fifty different birds from the Australian bush. An accompanying sheet identifies each track by number, gives the common name of each bird, its scientific name, the location at which the recording was made and the circumstances: e.g. "In mangroves along tidal creek".

On the recording itself, Miss Gillian Waite gives the number of the recording and the name of each bird concisely and in a professional manner. The bird recordings are of excellent quality, with very little background apart from the sound of other birds in the distance. These add effectively to the atmosphere and fill the gaps between phrases of the "soloist" of the moment.

Though reared in the bush myself, some of the sounds were new to me indicating, no doubt, the difference in the bird population of the eastern and western states.

This is a highly professional recording, which some will want for study, others for sheer enjoyment in a world which is oversupplied with man-made noise.

The recordings are available at $5.00 (including package and postage) from John H. Hutchinson, Gascoyne Research Station, Carnarvon, WA 6701. Orders can be accepted from April 1 onwards. (W.N.W.)

mixed in the orchestra is a Moog Synthesizer! A weird combination but it all fits together somehow. Following this is a very driving arrangement of "A Hazy Shade of Winter". The whole record is very listenable and will be great for parties when the fun begins to sag.

As can be imagined, the stereo spread is wide and spectacular. Pressing quality is good. The other tunes are: Bridge Over Troubled Water — Another Day — If — Make It With You — It Don't Matter To Me — Joy To The World — I Am . . . I Said — Lordy — Someone Who Cares — Come Again. (L.D.S.)

★ ★ ★

PARTY SINGALONG. Mrs Mills, with rhythm accompaniment directed by Geoff Love. Stereo, Parlophone series 275 SPEMO-9835.

Described in the notes (and as pictured) Mrs Mills is "a jolly, overweight hunk of humanity". Her "thing" was originally to play for dances, and the strict tempo style of a dance pianist is probably her most obvious quality. But her playing also has a happy sound, sufficient to launch her into British radio and television and to induce her audiences to sing right along. It has also paid for a number of overseas tours.

Mrs Mills builds again the atmosphere of those singalongs of the thirties and forties with her toe-tapping rhythms and her somewhat honky-tonk piano. Here she plays: Broadway Melody — Oh Susanna — Somebody Stole My Gal — Que Sera, Sera — I'll String Along With You and so on: fourteen in all.

Strict tempo, happy singalong and nostalgia — that's Mrs Mills. The recording quality is fine. (W.N.W.)

★ ★ ★

THE BEST OF LIVING STRINGS ON BROADWAY. Stereo, RCA Camden Special Series OCS-2479.

Geraldo, Johnny Douglas and Hill Bowen all make their contribution to the "Best Of" collection from the Living Strings orchestra. True to label, the orchestra lays down a strong foundation of strings, but a variety of other instruments emerge to take the lead. All round, however, it's a lush, easy-on-the-ear collection of sure-fire favourites: Tea For Two — Aquarius — Hello, Dolly — My Favourite Things — Sunrise, Sunset — The Impossible Dream — Maria — I've Grown Accustomed To Her Face — If Ever I Would Leave You.

Those who like the singing strings formula will love it. (W.N.W.).

★ ★ ★

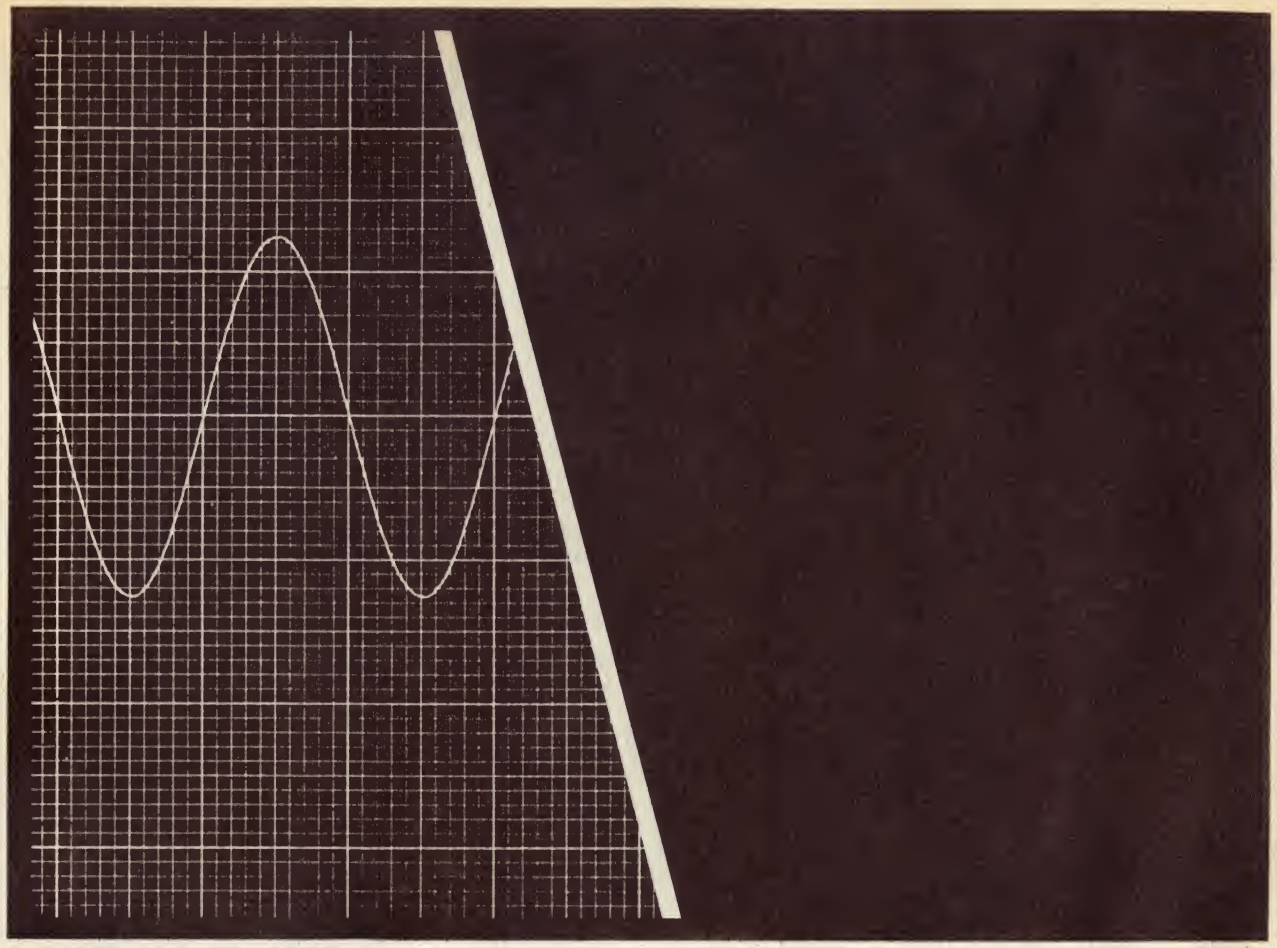
YOUNG & COUNTRY. Jim Reeves. RCA Camden Stereo OCS-2532.

"Young and Country" certainly is a good title for this disc as it was made very early in Jim Reeves' career. At the time it was made Jim Reeves had not developed his style to the point where he was pushed to world popularity. In fact, on this record he sounds just like any other C&W singer. Since it is a remaster job, the quality is poor. Unless you are a really keen fan of Jim Reeves you can miss this record.

The tunes on the disc, all written by Jim Reeves, include: Spanish Violins — You're the Sweetest Thing — Wagon Load Of Love — I Could Cry — Hillbilly Waltz. (L.D.S.)

SONGS OF JOY. Werner Muller and his orchestra. Decca (EMI) stereo PFS 4228.

The technique adopted by Werner Muller is very much the same as that made familiar by Waldo de los Rios — a fairly straighforward presentation of the music, with rhythm backing. However, Werner Muller is a much more experienced musician than the Spaniard, and his arrangements show more invention and all-round professionalism. Recorded in Decca's Phase 4 Stereo system, this disc has a lot going for it, and if the titles appeal, I feel you will not be disappointed if you buy: Song of Joy (Beethoven) — Theme from Piano Concerto No 21, "Elvira Madigan" (Mozart) — Forbidden Games (trad.) — Aranjuez Mon Amour (Rodrigo) — Air on the G String (Bach) — Theme from "2001" (Richard Strauss) — Adagio (Albinoni) — Gymnopedie No 2 (Satie) — Vocalise (Rachmaninoff) — Bachianas Brasilieras No 5 (Villa Lobos) — Symphony No 40 (Mozart). (H.A.T.)



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THOMAS EDMONDS ON TOUR. Stereo, RCA Victor SL-101959.

Following his win in the 1968 television "Showcase", tenor Thomas Edmonds recorded an LP which turned out to be one of the most successful ever recorded in this country. Its title: "The Voice of Thomas Edmonds".

As part of the prize for winning "Showcase" he is now in England working, studying and sightseeing. Prompted by the British scene, he recorded this new album in London. Curiously, however, the musical accompaniment was arranged and recorded in Sydney, flown to London to provide backing for the soloist, then returned to Sydney to be mixed with voice into a stereo master.

Don't let this piece of electronic skulduggery worry you; I doubt that you'll pick it even after you've been told. But you will enjoy the selection, magnificently sung: All The Things You Are — When Irish Eyes Are Smiling — How Are Things In Glocca Morra? — Take A Pair Of Sparkling Eyes — Autumn Leaves — The English Rose — The Scottish Soldier — Macushla — My Heart And I — The Road To The Isles — The Green Hills of Somerset — Goodnight My Friends.

One reservation: My cartridge has very small clearance above the record surface; on side 2, the outer contoured edge of this thin RCA pressing tended to lift the stylus out of the groove. I have heard others complain about these new pressings. (W.N.W.)

★ ★ ★

ANDY WILLIAMS. RCA Camden Stereo CCS-2525.

Usually, the notes on a record sleeve are just so much exaggeration. Occasionally, they are close to the truth. And this is the case with this album though certainly not in the way the copywriter intended. We are told to forget Andy Williams the long term television star and concentrate on Andy Williams the singer. And concentrate you must because the singer on this record bears little relation to the polished singer we know from TV. He sounds like a crooner in a B-class movie made in the early 50s . . . with orchestration to match.

And don't buy the record because it lists "Moon River" and "Hawaiian Wedding Song", two songs which Andy Williams can sing very well because he does not sing them on this disc — they are played by the Living Strings in a "salute" to Andy Williams. Most buyers would be incensed when they found this out after carting the album home. If you're still interested, you may as well go and buy it.

The tunes actually sung by Andy Williams are as follows: Here Comes That Dream Again — There's Just One You For Me — Why Should I Cry Over You — A-O-Lee-O — Now I Know — You Can't Buy Happiness. (L.D.S.)

★ ★ ★

AZNAVOUR SINGS AZNAVOUR IN ENGLISH. Barclay (Festival Recordings) Stereo SBCL-934352.

Charles Aznavour has said that his voice is froggy. I am inclined to agree. In fact I cannot see any reason for the popularity of many French singers. Maybe, to be fair, I should state that I do not like French singers. But sales of his records and the success of his live performances in Australia tell another story. Millions of people do like Aznavour. For those people, I am sure, this disc will be a must. He sings twelve of his songs, in English.

Some of the titles are as follows: It Will Be My Day — Life Is Sad — The Wine Of Youth To My Daughter — If I Had A Piano — I Will Give To You — The Town. (L.D.S.)

★ ★ ★

BARBRA JOAN STREISAND, CBS Stereo SBP 234023.

Barbra Streisand has put down some marvellous albums in the past but she does not appear to be at ease with the songs on this disc. If you are a Streisand fan you would be wise to have a listen before buying. Recording quality is normal.

Some of the selections are: Space Captain — Since I Fell For You — The Summer Knows (from "Summer of '42) One Less Bell To Answer. (L.D.S.)

★ ★ ★

NANCY WILSON: A TOUCH OF TODAY. World Record Club stereo S/4974.

Some records can be difficult to review. They may be neither outstanding nor poor but one cannot list them as mediocre, just routine. This is one of those discs. Nancy Wilson gives a good performance but the record as a whole, is not outstanding. Recording quality is up to WRC's usual high standard.

Some of the tracks are: You've Got Your Troubles — And I Love Him — The Shadow Of Your Smile — Call Me — Yesterday — No One Else But You. (L.D.S.)

★ ★ ★

LAUGHTER UNLIMITED — Volume 1. World Record Club "Retrospect" Series, mono W.R.C.-3143.

If the title of the first track on this disc — "A Fruity Melodrama" — means anything to you, or the line "What's wrong with the wicker whatnot — it's sneering", you will know what to expect to find in the six tracks included here.

In fact, these are from humorous recordings of the 1930s which were all famous in their day, featuring such popular Music Hall and Variety artists as Flanagan and Allen, Harry Tate, Oliver Wakefield, Horace Kenney and others. For the initiated, the titles will be enough: A Fruity Melodrama — The Scoutmaster (by John Tilley) — A Music Hall Trial Turn — Running an Office — Play Up and Pay the Dame (by Oliver Wakefield) — "Cinderella" Crazy Pantomime.

Well, there it is. If your household owned the original 78s of these, you would probably have spent many happy hours chuckling over the situations depicted.

Do not expect good quality sound — in some tracks it is barely acceptable. But in every case, the diction is clear and understandable. (H.A.T.).

★ ★ ★

GLEN CAMPBELL COUNTRY. Capitol stereo SENC-9845.

Glen Campbell continues to ride the wave of popularity with this album, singing numbers that are his own hits, such as "Galveston" and many others. The recording quality is fine and the record surface of my sample had negligible noise. It is sure to be a big seller.

Twelve tracks are featured, including: Try A Little Kindness — Honey Come Back — By The Time I Get To Phoenix — It's Over — True Grit — Me and My Guitar — Mary In The Morning. (L.D.S.)

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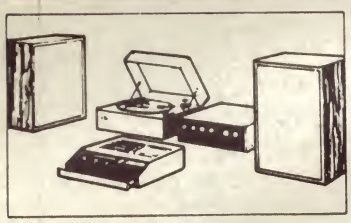

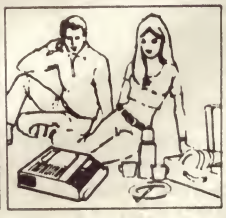

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NAME.....

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PASTORALE. Rod McKuen, vocals, with the Westminster Symphony Orchestra, conducted by Arthur Greenslade. Warner Bros two record set stereo 2WS 1894.

Rod McKuen writes delightful melodies and his lyrics have a poetical quality while still retaining a simplicity of style. His success as a song writer is therefore well merited. It is his success as a performer which puzzles me. He certainly cannot sing, and his method of talking with a husky croak when the tune moves outside his limited register must amuse artists better endowed with vocal equipment. Yet people flock in their thousands to hear him, and his discs apparently sell well. If you are one of those who appreciate his peculiar style, here is a two disc set for the special price of $8.95.

Unlike most special sets, the tracks in this are not selected from previous releases. They were recorded complete in 1970 in London, with the backing provided by the one orchestra and conductor. There are 26 tracks in all, too many to list in full, but here is a sample list to whet your appetite: Three — Pastorale from "Fields of Wonder" — The Green Hills of England — I Think of You — Fields of Wonder — The Railroad Song — Yet Another Sunset — The Single Man. All the foregoing are McKuen's own compositions, but some tracks are by other composers. In "The Winds of Change", the lyrics only are by McKuen, the melody being based on a quotation from Joaquin Rodrigo's "Concierto de Aranjuez". George Harrison's "Something" and Marian Segal's "Fly Me to the North" are typical of the remaining tracks.

The orchestra performs well throughout, but so as not to overwhelm McKuen's croaky whisper, the recording engineer has kept its contribution at low level, while keeping the vocal at as high a level as he dared. The effect is far from satisfying musically. (H.A.T.)

★ ★ ★

THIS IS THE NASHVILLE SOUND. Various artists. RCA Victor, two record set stereo VPS-6037.

This must be the greatest galaxy of C & W stars ever assembled in one package. Among the big names presented in this double album are Eddy Arnold, Skeeter Davis, Charley Pride, Jim Reeves, Hank Snow, Floyd Cramer, Dottie West, Norma Jean, and, of course, as the set is from RCA, Chet Atkins, who heads the company's C & W division. Each of these has numerous discs to his or her credit, and will certainly be known to buyers of C & W.

Apart from mentioning that the sound is generally quite clean and adequate for this kind of material, I need do no more than give a few of the titles. If you are interested, you can follow it up from there.

Mule Skinner Blues (Dolly Parton) — Is Anybody Goin' to San Antone (Charley Pride) — Snowbird (Chet Atkins) — From Heaven to Heartache (Eddy Arnold) — Columbus Stockade Blues (Danny Davis and the Nashville Brass) — Strollin' (The Nashville String Band) — Angels Don't Lie (Jim Reeves) — Whiskey — Six Years Old (Norma Jean) — Mornin' (Jim Ed Brown). There are 24 tracks in all, and the set is offered for the special price of $7.95. (H.A.T.)

I GOT LUCKY. Elvis Presley. Mono, RCA Camden OCL-2533.

No one can argue that Elvis certainly has "got lucky". At 37 years old he is still the undisputed "King" of pop, despite a strong challenge from the Beatles.

Elvis sings a selection of songs from his movies, including the title track, "I Got Lucky", from "Kid Galahad". Other tracks are What A Wonderful Life — I Need Somebody To Lean On — Yoga Is As Yoga Does — Riding The Rainbow — Fools Fall In Love — The Love Machine — Home Is Where The Heart Is — You Gotta Stop — If You Think I Don't Need You.

The performance is well up to the usual Elvis standard, and the recording is clean. It is possibly a good recording to have of Elvis in that it presents a fair cross-section of his work. No doubt for the dedicated Elvis fans it will be another to add to the dozens previously released. (R.P.T.)

★ ★ ★

ROLLIN' FREE. John Laws. Stereo, HMV (EMI) SOELP.9765.

John Laws seldom fails to please his following — whether it be on radio, or on disc — with his poetry, and now "Rollin' Free" — a collection of songs which Laws has put together because "I have made an album which sounds like me singing the kind of songs I want to sing . . ."

And the songs on the record are all very good. They are by composers such as Cash, Silverstein, Kristofferson, Russel, etc. What's more, Laws does sing them with sincerity and meaning — as if he is enjoying singing them as much as I was enjoying listening to them.

The 12 titles are—Rollin' Free—Goodbye — Comin' After Jinny — Sunday Morning Comin' Down — 1432 Franklin Pike Circle Hero — Little Green Apples — Sailor On A Concrete Sea — Gentle On My Mind — Precious Baby — Approaching Lavender — Jumbo's Place — Then She's A Lover.

At the price of $2.75, this record represents very good value for money. A sampling track? I don't think I can pick one — they are all good. (R.P.T.)

Jazz and Rock . . . .

STEPHANE GRAPPELLI 1971. Astor stereo SPLP 1356.

They've changed the spelling of his name but nothing else has altered the superb mastery of the great jazz violinist.

Grappelli recorded this LP in London in October, 1970 with pianist Alan Clare and drummer Tony Crombie. The classic charm, form and structure of a performance of improvised jazz is an integral part of every track.

Back in the days of the Quintet of the Hot Club of France it was accepted that Grappelli set the stage for the gypsy guitarist Django Reinhardt. Those who argued for Grappelli will find themselves vindicated by this LP. He is one of those rare stylists who did not find it necessary to sacrifice the tone and quality of his beautiful instrument in order to create a hot exciting melody.

"Making Whoopee", "Running Wild", "Ain't Misbehavin", and "You Make Me

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Please send technical information on Lux amplifiers.

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Feel So Young" are some of the tunes which come rolling from the disc. Alan Clare's piano matches Grapelli's inventiveness and I wonder why we haven't heard more of him.

The sound equipment used has captured the full resonance of the violin strings. Stereo is lifelike. (G.W.)

★ ★ ★

ART BLAKEY'S JAZZ MESSENGERS WITH THELONIOUS MONK. Atlantic stereo 1278.

A press drum roll opens the performance of "Blue Monk" on this LP of late fifties jazz. Perhaps the recording was made later but I doubt it. The stereo is minimal, but that's not what we are listening for.

This is a 12-bar blues from the thoughtful cool of those days. Monk is heard not only as soloist but also as an exciting accompanist behind the solos of tenor sax player Johnny Griffin and trumpeter Bill Hardman. His gentle coaxing of Spanky DeBrest's double bass solo is delightful.

The way in which Monk alters the rhythmic and harmonic patterns of a given tune has intrigued jazz buffs ever since they sorted him out of the bebop mainstream and discovered that he was a unique stylist going back to the blues roots of jazz improvisation. His two choruses on "I Mean You" have to be heard a couple of times in order to get below the surface, but they tell a lot about Monk's style.

The performance is nicely spaced out; wonderful listening for the late hours. (G.W.)

★ ★ ★

THIS IS DUKE ELLINGTON. RCA original recordings VPM-6042.

There have been many re-issues of early Ellington sides. This two-LP set contains the most popular and worthwhile sides from the era 1927 to 1945.

"Black and Tan Fantasy", which set the pattern for so many jazz concert pieces to follow, is the breath-taking opening to the set. "Creole Love Call" from the same session, follows. There are many early numbers. The surprise is the inclusion of the session sides in the 1940s in which the Duke virtually sat in as his soloists performed the bracket which included "Never no Lament" and "Concerto for Cootie". From a few years later come "Perdido" and "Take the A Train" which was featured in an early wartime movie.

The mono recordings have been remastered to suit stereo playing gear without sacrificing the characteristic crispness of the twenties shellacs. (G.W.)

★ ★ ★

PRESENTING THE COUNTRY BLUES. Roosevelt Holts. Blue Horizon mono 7-63201.

Roosevelt Holts doesn't appear in any of the learned books about the country blues and there's no reason why he should. He is a blues picker and singer who listened and played around Tylertown, Louisiana, and did not make a record until collector David Evans found him in 1966. Holts was 61 at the time.

His voice is typical uncomplicated southern blues. His guitar style combining a lyrical grace of picked solos with shimmering bottleneck slides.

Holts sings "Prison Bound Blues", "Big Road Blues", "Lead Pencil Blues" and "Little Bitty Woman", but the titles don't mean much. He constructs his blues from phrases and images which recur in southern laments. His spirituals "I'm Going to Build Right on That Shore" and "The Good Book Teach You", have the character of country church about them.

Holts is not the showman that Big Bill Broonzy was, but this record has the excitement which the Broonzy Philips recordings had when they appeared in the fifties. (G.W.)

★ ★ ★

IMAGINE, John Lennon and the Plastic Ono Band. Apple stereo PAS 10004.
WINGS WILD LIFE. Paul and Linda McCartney. Apple stereo PCSO 7142.

The two halves of the celebrated songwriting partnership of the Beatles continue to go their separate ways.

On the one hand Lennon is didactic, almost prosey, as he desperately tries to get through with his ideas which these days are mostly political.

Lennon is at the centre of a movement which uses music to question and examine beliefs. His new LP makes effective use of the piano to get through to the listeners.

The title tune "Imagine" is structured with the simplicity of an early Beatles tune. The lyric carries a vision of peace. The Plastic Ono Band jams well on the blues "I Don't Wanna Be a Soldier Mama I Don't Wanna Die". Nicky Hopkins plays good piano.

Lennon has written a song criticising McCartney which is called "How Do You Sleep?"

It's not surprising to find this answered by McCartney on HIS record with one called "Dear Friend".

Just when the heavyweight title of the rock business will be decided we don't know but I don't think that the public should be expected to subsidise the argument.

McCartney and his wife continue the eclecticism which has dominated their recent approach to pop music. This produces shallow numbers like "Bip Bop", "Wild Life" and "Love is Strange". It is transistor-radio music and utterly forgettable.

Both albums have written on them counter-claims concerning the copyright of the songs and the former partnership seems to be consumed by conflict. It's a rather sad sequel to something which began on the theme of "All You Need is Love". (G.W.)

★ ★ ★

CAHOOTS. The Band. Capitol stereo ST 651.

The newest LP by this influential American group shows the descriptive quality of the writing by Robbie Robertson. All of the songs, except Dylan's "When I Paint My Masterpiece", are by Robertson.

They are as descriptive as a movie scenario. Robertson describes his surroundings and delineates characters. Thus we have modern music which shows the influence of years of movie watching. "Stage Fright" on a previous band LP was named after a Hitchcock movie. "Smoke Signal" on this LP, describes the watching of a civil war movie. The opening song "Life is a Carnival" is an inside-outside affair, a story of life experienced on the one hand and watched objectively on the other.

Musically, the band keep to their five member harmonies with great atmospherics. (G.W.)

PRODUCT REVIEWS AND RELEASES

Wharfedale Linton Stereo Amplifier

Well known for loudspeaker systems, Rank Wharfedale Ltd has now introduced a solid-state stereo amplifier, the Linton. It has a continuous power output capability of 15 watts per channel at less than 0.1% harmonic distortion.

Compared with the pretentious styling of many Japanese amplifiers, the Wharfedale Linton looks rather conservative with only four knobs and five lever switches to grace its polished front panel. While these provide all the necessary control facilities, the omission of a stereo headphone socket does seem strange, as even the cheapest amplifiers have one fitted.

Control functions provided by the four knobs are bass, treble and balance and off / on-volume. Three lever switches provide a choice of input selection between phono, tuner and tape. The other three switches are tape monitor, filter and stereo / mono selector. All switches have a positive action and the knobs rotate reasonably smoothly, although not as silky as some amplifiers of Japanese origin. The pilot light is very small and not bright enough. In daylight, it is not at all easy to see whether it is on or off.

A timber case is fitted and included in the basic price. The method of construction of the case and chassis was unusual to say the least. While it was a relatively straightforward matter to remove the metal plate attaching the case to the chassis, we could not remove the amplifier from the case since the front panel appears to be an integral part of the case. Indeed we could not see how the internal fuses could be changed or any service done on the amplifier, without dismantling the case.

The rear panel, like the front panel, is comparatively uncluttered. Two AC outlets and two loudspeaker fuses are provided, along with a pair of 2-pin DIN sockets for loudspeaker connection. Four phono sockets are provided for input, output and output connection to a tape recorder, and an additional four provide disc and tuner inputs. Each of the latter two inputs have an associated slide switch to adjust the input sensitivity.

Sensitivities for the phono input are 3.5mV at 47K input impedance for magnetic cartridges or 20mV at 33K for ceramic cartridges. Tuner sensitivities are 60mV or 250mV, both at an input impedance of 50K. These sensitivities apply for stereo operation into 8-ohm loads. If the amplifier is switched to mono operation with a single channel or stereo source, the gain drops by 6dB, quite a perceptible difference.

Filters on most amplifiers are little more than a sales gimmick as their rate of attenuation is not rapid enough. But the Wharfedale amplifier scores here as the filter gives an attenuation of 12dB / octave above 6KHz. This makes it far more effective on surface noise and tape hiss.

It is not possible to comment in detail on the circuit configuration of the amplifier but we were able to determine that it has quasi-complementary output stages and that the output coupling capacitor appears to be connected within the main AC feedback loop. This was deduced from the fact that, at low frequencies, the output impedance does not show the usual rise for capacitively coupled loads but instead becomes negative to maintain a high effecitive damping factor over the whole audio range.

Easily the most impressive feature of the Wharfedale Linton is the way in which it meets or exceeds its comprehensive specification. It is not often that we can make this statement.

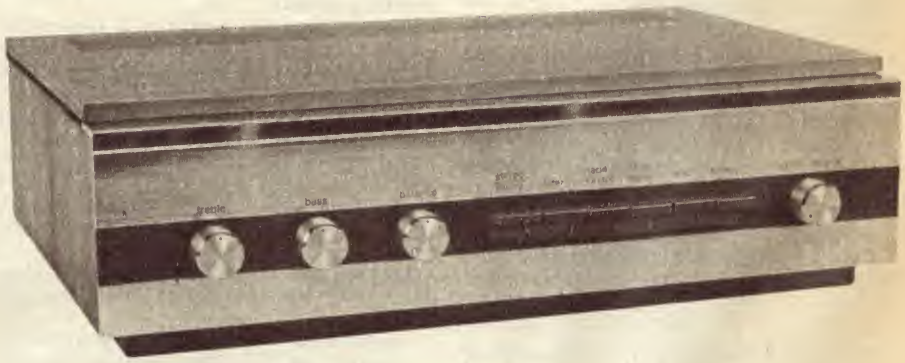
Continuous power output into 16 ohm loads was measured at 11½ watts at 1KHz for one channel, or 10 watts per channel with both channels driven. Power into 8 ohm loads was 18 watts for one channel or 15 watts per channel with both driven. Into 4 ohm loads, measured power was 25 watts for one channel or 18 watts per channel with both driven. With 8 or 16 ohm loads, harmonic distortion never exceeded 0.1% at all power levels up to clipping for frequencies in the audible range. With 4 ohm loads, distortion was 0.6% at full power but rapidly reduced at lower power levels. No cross-over distortion was evident.

Frequency response at a level of 1 watt was ±1dB from 30Hz to 20KHz, as specified. The tone controls provide a range of ±16dB at 50Hz and 14KHz. RIAA compensation of the phono input was within 1dB of the curve from 50Hz to 15KHz and the overload margin was adequate — 45mV at 1KHz.

Separation between channels was —52dB with spect to 15 watts into 8 ohms between 100Hz and 1KHz, and -30dB at 10KHz. These figures applied for all inputs. Signal-to-noise ratio for the 250mV tuner input was -68dB with respect to 15 watts and -50dB for magnetic cartridge input.

The square wave response at 1KHz showed only a trace of overshoot, and the stability with capacitances up to 1uF shunting the loudspeakers was excellent. The amplifier is not prone to mains radiated interference and we experienced no problems with radar pulses or other extraneous RF signals. At switch-on the loudspeakers do emit a "thump", but this is quite mild. A worse thump occurs when selecting input source with the lever switches if the gain is advanced to a high level.

In use, the amplifier is very easy to drive and the variable controls are smoothly progressive in contrast with some amplifiers where all the tone and balance control action is concentrated at the extremes of control rotation. At all times the amplifier was very quiet and full power testing for long periods did not worry it in the least. It remained cool all the time.



The Wharfedale Linton can be summed up as a no nonsense high quality amplifier. Everything works as claimed and it has no unnecessary frills.

The Linton will be available from retail outlets throughout Australia. Further information can be obtained from the Australian distributors for Wharfedale, Simon Gray Pty Ltd, 29 Elizabeth Street, Melbourne, Victoria. (L.D.S.)

Empire 1000ZE/X Magnetic Cartridge

Over the past few years manufacturers' top-of-the-line pickup cartridges have become increasingly expensive but at the same time their performance has been much improved. The 1000ZE / X is the top of the Empire line and few cartridges can compare with it.

As with most things, high fidelity equipment conforms to the law of diminishing returns — "the more you pay, the more subtle the improvement becomes". But the Empire 1000ZE / X seems to be the exception that proves the rule. It is audibly better than the other cartridges in the Empire range, and most of those of other manufacturers.

The 1000ZE / X has a moulded plastic body and a removable stylus assembly which incorporates a flip-down stylus guard. Finish is black and gold. Mu-metal shielding and hum-bucking connection of the four internal coils result in a cartridge with very low residual noise output. Cartridge weight is 7 grams.

The foot of the cartridge is slotted to allow it to be mounted in headshells with the standard 12.7mm (½ in) mounting centres. Even so, this operation can be rather fiddly as the wide body of the cartridge tends to foul the screws while they are being driven home. The output terminals of the cartridge are coded with letters moulded into the plastic body but colour coding would be more effective for those whose sight is not as keen as it might be.

Tracking force range of the cartridge is listed as ¼ to 1¼ grams and lest the lower limit seem a little frivolous, let us state that it is possible to track many records at this very low setting, if the tone arm is capable. Our sample was set up in a very high quality arm of Japanese origin. We found that maximum tracking capability was realised at a setting of 1 gram and no improvement was noticeable above this setting. At 1 gram, the 1000ZE / X tracked the +16dB drum test track of the W&G 25 / 2434 test record and thus achieved the best tracking performance of any cartridge we have tested to date.

Frequency range of the cartridge is quoted at up to 40KHz and is claimed to be suitable for 4 channel discs. Since these are not likely to be available in Australia for some time we did not attempt to verify these claims. Separation between channels is quoted at 35dB but frequency is not specified.

Frequency response and separation between channels was checked using the CBS STR-100 test record and a Hewlett-Packard 331a distortion analyser as an Ac millivoltmeter, with a load of 47K. Tracking weight was 1 gram.

Under these conditions, the frequency response

Monsanto Led's

Hawker Siddeley Electronics Ltd have released a range of Monsanto light-emitting diodes and displays, light detectors and other opto-electronic components.

Red and green light-emitting diodes are available with total external radiated power capability up to 0.1mW. Infra red diodes are available with similar ratings up to 10mW and power dissipation ratings up to 3 watts.

Four light detectors are included in the range. The MD1 and MD2 diodes have breakdown voltage ratings of 50 volts and rise time of 0.5 nanoseconds. The MT1 and MT2 phototransistors have breakdown ratings of 30 volts and rise times of 2 microseconds.

There are four basic light-emitting displays. They are monochromatic red, seven-segment alpha-numeric displays suitable for military or industrial applications. They are available in 10 and 14-pin packages or in printed board assemblies with or without built-in decoder-drivers.

Rated brightness of the displays ranges from 350 foot-lamberts at a forward current of 20mA to 200 foot-lamberts at a current of 5mA and peak emission wavelength is 6500 Angstroms.

Other items in the Monsanto opto-electronic range are GaAs Opto-isolators which consist of a GaAs diode and photodiode, phototransistor or photo silicon controlled-rectifier.

Trade enquiries regarding the Monsanto range of opto-electronic components should be directed to Hawker Siddeley Electronics Ltd, 752 Pittwater Road, Brookvale, NSW 2100.

EMPIRE CARTRIDGE . . .

checked out at ±1dB from 20Hz to 2KHz; above this it tapered to —3dB at 4KHz and remained at this level up to 20KHz, the highest test frequency on the disc. Behaviour of both channels was near identical, i.e., channel balance was within ½dB over most of the range. Separation between channels was —33dB in one direction and —23dB in the other, at 1KHz and never less than —20dB over the range from 100Hz to 10KHz, which is excellent.

Waveform of the cartridge over most of the range was very clean and the unit was able to track the high amplitude sine waves recorded on the CBS STR-110 very well. Sensitivity of the cartridge was low at less than 1mV / cm / sec but this should not be a problem with most modern amplifiers. Since the cartridge is very quiet the amplifier gain may be wound up high before noise becomes obtrusive.

(Continued on page 105)

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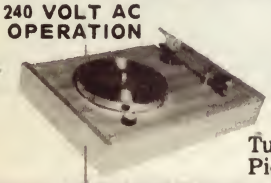

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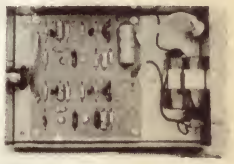

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Connoisseur and Micro Equipment

In spite of the widespread popularity of automatic changers many enthusiasts prefer to "assemble" their player from a variety of sources. Such a combination is the Connoisseur BD1 turntable, Micro MA-101 tone arm and Micro 4100/e moving coil cartridge submitted for review by International Dynamics (Agencies) Pty Ltd.

By careful choice, the enthusiast can save a lot of money on a combination of components but still end up with a high performance player. The Connoisseur BD1 is a very good illustration of this approach. At price of $39.50 it must be one of the cheapest turntables on the market. It has a 10¼ inch cast aluminium platter weighing 2½ lb with a precision ground steel spindle running in a phosphor bronze bearing. The platter is belt driven by a 16-pole synchronous motor running at 375 rpm.

Power consumption is a modest 5 watts and the two-core flex is fitted with a 2-pin plug to connect to the amplifier AC outlet.

Two speeds are provided, 33 and 45 rpm. Speed change is accomplished by manually lifting the belt on to the appropriate pulley section — which seems primitive at first but is at least worth full marks for simplicity! The start lever carries a rubber bung which brakes the turntable when it is turned off and gives it a nudge in the right direction when starting, to help the motor get the platter up to speed. When running, the unit has just as much torque as other belt driven turntables and it comes up to speed almost immediately.

Finish of the turntable baseplate is black hammertone and the only grumble we had with its overall presentation was that the plastic pulley cover had some rough edges.

Money saved on the turntable can be spent on the tone arm, the Micro MA 101, for example. This is an offset arm with an effective length from stylus to pivot of 9⅜ inches. The head-shell has the standard EIA locking collar as used on SME and Ortofon arms, and accommodates cartridges with ½inch mounting centres. The cartridge mounting plate has a range of adjustment for stylus overhang and the headshell socket in the arm has a small locking screw which can be loosened to set the cartridge vertical with respect to the record surface.

Balancing in the vertical plane is accomplished by the counterweight which is split in two sections, one sliding upon the other. Once the arm has been set in balance the whole counterweight assembly is rotated towards the arm pivot to set the stylus tracking weight, which is variable over the range from 0 to 3 grams. Anti-skating bias is provided by spring tension which is adjusted by rotating a boss on the arm pivot.

Height adjustment is more than adequate, with a range of over 2 inches. The arm cueing lever is hydraulically damped in both directions so that the cartridge is smoothly lifted off the record surface as well as smoothly lowered. This avoids a thump from the loudspeakers when the arm is raised. Setting up the arm is straightforward, bearing friction is very low and the tracking weight calibrations are accurate to within better than 5%. Using this arm and premium grade cartridges we were able to track some records as low as ¼ gram without audible distortion.

Some enthusiasts may sneer at the combination of a relatively cheap turntable with an expensive arm but one could spend a lot more money and end up with inferior performance to this combination. The turntable operates very quietly, a slight "shushing" noise coming from the motor. Rumble was so low that we could not measure it and wow and flutter were certainly not apparent to the ear, which is more than can be said of some other turntables with a much higher price.

Rounding out the player combination is the Micro 4100/e moving coil cartridge which has several unique features. Firstly, it is unusual for a moving coil cartridge to have a replaceable stylus assembly. In reality, the assembly contains all but the magnets and output terminals! The stylus is protected when not in use by a flip-down stylus guard. Tracking weight range is ½ to 2½ grams and the quoted frequency response is 20Hz to 20KHz within +2.5dB and —0.5dB.

Since the Micro 4100/e is a moving coil unit with low impedance and minuscule output it requires a preamplifier to step up the output to the level normally handled by RIAA preamplifiers. The MTA-41 preamplifier is specially designed for this application with very low noise output and negligible distortion. The circuit is a grounded-base stage with a voltage gain of 30dB and powered from a nine volt battery.

A three-position slide switch is fitted to the preamplifier to allow either of two nine volt batteries to be used (in case one is flat). The third position of the switch allows signals from the cartridge to pass through unmodified, as would be the case if a conventional cartridge was temporarily fitted to the headshell. Current drain of the preamplifier is about 1mA and the batteries should have long life since it works satisfactorily even with the battery down to 4V.

While the preamplifier has a very low noise output it does cause a sharp crack from the loudspeakers when it is turned on or off. The volume control should be turned down when this is done!

Tracking performance of the 4100/e is perhaps not quite as good as can be obtained from moving magnet cartridges. It required 1.7 grams tracking weight to take the +12dB track of the W&G 25/2434 test record, which is good, but 2½ grams were required to track the +16dB band. Perhaps we should add that many cartridges will not track this band at all. All normal records could be tracked at 1½ grams and this was the setting used for subsequent tests.

Frequency response was exceptionally smooth from 20Hz to 20KHz within +2dB and —1dB, which is just about as close as any cartridge we have tested has ever come to its specification. Separation between channels was a consistent — 16dB over the whole range in one direction and a maximum of 26dB in the other, with a minimum of —16dB at 16KHz. Square wave response was very good, as can be expected from the frequency response.

It is hard to place an interpretation on the sound of this cartridge. It is always very pleasant but is subtly different from comparable moving magnet cartridges. Certainly, it warrants consideration for inclusion in the highest quality systems.

So there it is — a very fine player combination for well under $200. The Connoisseur BD1 can be purchased complete for $39.50 or in kit form for $34.50. The Micro MA 101 arm goes for $59.50 and the Micro 4100/e with matching MTA41 preamplifier sells for $64. Price of the cartridge separately is $39.50.

Connoisseur turntables and the Micro arm and cartridges are available from selected retail outlets throughout Australia. Trade enquiries should be directed to the Australian distributors for these products, International Dynamics (Agencies) Pty Ltd, 23 Elma Road, North Cheltenham, Victoria, 3192. (L.D.S.)

ALL PRICES INCLUDE TAX AND POSTAGE

IMPORTED COMPONENTS

P.O. BOX 1683P, MELBOURNE 3001

1N645	.84
1N914	.51
IN3491 + R	1.75
IN3492 + R	1.83
1N3493 + R	2.36
1N3660 + R	1.99
2N174	6.09
2N217	1.24
2N277	2.32
2N301	2.66
2N301A	3.84
2N384	2.88
2N406	1.01
2N417	1.77
2N441	1.80
2N443	3.22
2N456A	4.20
2N489B	14.76
2N591	2.20
2N649	2.12
2N696	1.13
2N697	1.17
2N706A	1.80
2N930	1.80
2N1038	3.92
2N1046	17.94
2N1073B	7.59
2N1302	1.01
2N1303	1.01
2N1305	1.13
2N1306	1.32
2N1307	1.32
2N1308	1.64
2N1309	1.64
2N1546	5.85
2N1639	1.20
2N1908	27.74
2N2102	2.78
2N2147	3.60
2N2148	3.60
2N2160	2.40
2N2188	2.79
2N2270	2.40
2N2646	2.19
2N2647	3.15
2N2669	6.53
2N2926	2.25
2N3005	5.32
2N3054	1.80
2N3525	3.70
2N3563	.90
2N3564	1.08
2N3565	.86
2N3566	1.01
2N3567	1.08
2N3691	.86
2N3692	.90
2N3694	.90
2N3702	1.01
2N3703	.96
2N3704	1.77
2N3705	1.73
2N3706	1.65
2N3707	1.14
2N3708	.80
2N3716	5.30
2N3731	3.17
2N3790	11.25
2N3819	1.77
2N3826	1.68
2N4121	1.04
2N4250	1.17
2N4354	1.28
2N4355	1.65
2N4356	1.65
2N4360	1.58
2SB186	1.50
2SB407	3.30
2SB474	3.30
2SD150	1.50
2SF28	5.60
3N140	2.55
3N141	2.34
AA119	.36
AB1101	1.20
AB1102	.87
AC107	2.28
AC125	.96
AC126	.96
AC187 / 188	2.36
AC128	1.05
AC132	1.01
AC172	1.20
AC187188	2.36
AD149	2.45
AD161 / 162	4.32
AN1102	.68
AN1103	.60
AN1104	.60
AN1105	.60
AN2001	.45
AN7102	.90
AN7105	.68
AS147	.80
AS148	.76
AS208	1.46
AS301	.81
AS306	.84
AS307	.84
AS308	.84
AS310	.99
AS311	.96
AS312	.93
AS313	.92
ASY73	2.12
ASY76	2.10
ASY77	1.68
AS216	3.03
AS217	2.59
AS218	2.91
AS220	.98
AS221	2.16
AT316	.68
AT318	.68
AT319	.69
AT321	.69
AT322	.63
AT323	.68
AT324	.68
AT325	.83
AT331	.92
AT337	.69
AT338	.70
AT341	.70
AT350	1.14
AT1138	2.66
AX1101	1.53
AX1103	1.70
AX1104	1.86
AX1108	1.86
AX1127	1.50
AX1130	1.50
AX1131	1.77
AX1132	1.50
AX1142	1.20
AX1143	1.58
AX1144	1.44
AX1166	1.37
AX6168	1.98
AY1102	1.04
AY1108	1.65
AY1113	.69
AY1119	.60
AY6108	1.65
AY6109	1.65
AY8108(8103)	3.75
AY8109(8104)	3.00
AY8112	6.75
AY8135	5.40
BA100	.44
BA102	1.46
BA114	.39
BC107	.83
BC108	.76
BC109	.91
BC147	.76
BC148	.68
BC149	.79
BC157	.89
BC158	.76
BC159	.89
BC177	.91
BC178	.84
BC179	.92
BC186	.79
BC207	.72
BC208	.63
BC209	.75
BC212	$2.00
BCY10	2.59
BCY11	3.24
BCY12	3.14
BCY39	5.19
BCY71	2.05
BCZ210	1.95
BCZ211	2.37
BCZ212	2.16
BD139	3.67
BD140	3.90
BDY20	2.63
BDY38+	2.62
BF115	.87
BF145	.64
BF173	1.14
BF177	1.63
BF178	1.80
BF179	2.04
BF184	.72
BF185	.72
BF194	.67
BF200	1.32
BFY51	5.19
BSX19	2.16
BSX20	2.39
BT100A / 500R	3.00
BT101 / 500	5.40
BTY79 / 100R	2.70
BTY79 / 300R	3.45
BTY79 / 500R	5.19
BY127 / 800	.78
BYX21L / 200R	1.35
BYX38 / 300 + R	1.32
BYX38 / 600 + R	1.62
BYX38 / 900 + R	2.08
BYX38 / 1200 + R	3.03
BYX39 / 600 + R	3.14
BYX39 / 800 + R	3.88
BYX39 / 1000 + R	4.53
B2X70Scvies	1.95
B2Y88C303toC11	.83
B2Y88C12toC30	.98
BZY95 Scvies	2.16
BZY96 Scvies	2.16
BZZ15to29	2.37
C20D+	6.60
C106 / Y1	2.10
C122D	3.78
D13TI	1.95
DTG110B	6.96
DTG1010	15.16
EM402	.45
EM408	.80
EM410	1.40
FLV100	3.30
FPT100	1.80
H35	8.07
MB1	2.03
MB3	2.65
MB6	3.40
MB8	4.30
MJE2955	4.55
MJE3055	3.06
MPF104(Fet)	1.10
OA5	0.65
OA10	0.87
OA47	0.65
OA90	0.32
OA91	0.33
OA95	0.39
OA202	0.75
OC20	6.38
OC22	3.03
OC23	3.80
OC24	3.45
OC44N	1.11
OC45N	1.11
OC74N	0.96
OC140	1.95
OC141	2.60
OC201	3.80
OC202	3.70
OCP70	2.60
OCP71	4.32
ORP12	0.95
ORP60	1.75
PA40	4.83
PB40	7.26
SC45D	11.10
SC50D	13.00
SC146D	3.70
SE2001	0.98
SE2002	1.20
SE3001	1.12
SE5001	2.10
SE5002	2.10
SE5003	2.48
SE5020	4.05
SE5023	3.15
SE5025	1.35
ST2	1.50
T1 / 40 / A2	3.30
T13027	2.61
TIC44	1.68
TIC45	1.88
TIC46	2.05
TIC47	2.30
TIP31A	2.10
TIP32A	2.70
TIP33A	2.98
TIS34	2.46
TIS43	2.36
ZD Series	1.98
40360	2.48
40361	2.70
40407	2.52
40408	2.98
40409	3.15
40410	3.30
40411	9.70
40669	3.50
FETS	
2N4889	2.70
2N5245	2.62
2N5459	1.77
2N5485	1.77
MPF102	1.00
I.C.'S	
FUL709	1.75
FUL723	3.95
FUL739	5.10
FUL900	1.20
FUL914	1.20
LM370	6.75
LM372	5.62
MC1303	5.20
PA246	13.60
TAA300	4.32

SPECIALS

AY1101	.35 ea.
AY1103	.55
AY1104	.74
AY1110	1.07
AY1112	.61
AY1115	.49
AY1116	.49
AY1117	.49
AY1120	.67
AY1121	.67
AY8110	2.59
AY8111	2.59
SE1001	.35
SE1002	.56
SE1010	.61
SE4001	.48
SE4002	.55
SE4010	.62
SE7001	2.80
2N3053	1.57
2N3054	1.80
2N3055	1.30
2N3568	.67
2N3569	.71
2N3638	.60
2N3638A	.75
2N3640	.97
2N3641	.61
2N3642	.81
2N3643	.75
2N3644	.81
2N3645	1.00
2N3646	.73
2N3693	.35
EM404	.26

MICRO-DEC SOLDERLESS BREADBOARD

General Electronic Services Pty Ltd have a range of Micro-dec solderless breadboards and accessories. They can be used with discrete components and with the aid of adaptors, integrated circuits.

Pictured is a Micro-dec breadboard module which accommodates both discrete components and integrated circuits. Patching may be carried out with ordinary solid core wire and modules may be dovetailed together to form breadboarding areas of suitable size.

Contacts are formed from electrical grade phosphor bronze and are laid out in parallel rows in similar fashion to general purpose wiring board. The prearranged bus-bar pattern is shown by raised lines on the board surface.

The integrated circuit adaptors allow the use of dual-in-line packages with up to 16 pins or TO-5 packages up to 10 pins. Each module can accommodate up to 4 TO-5 IC's or 2 DIL IC's. Alternatively, they can accommodate six to ten discrete component stages.

Micro-dec breadboard modules are intended for research and development work in industry and for demonstration use in educational establishments.

They may be temperature cycled and maximum operating temperature is 130 degrees Celcius.

Trade enquiries regarding Micro-dec breadboard modules and accessories should be directed to General Electronic Services Pty Ltd, 114 Alexander Street, Crows Nest, NSW 2065 or Suite 306, Westfield Tower, Doncaster, Victoria. 3108.

EMPIRE CARTRIDGE . . .

Strangely enough, for a cartridge with a claimed frequency response to 40KHz, the square wave response was not ideal but showed a degraded rise time, at a fundamental frequency of 1KHz. At first we thought this might be due to excessive cable capacitance from the tone arm to the millivoltmeter but this was not the case, as the arm we used proved to have very low cable capacitance.

On music, the cartridge gives a superb performance and one forgets about attempting to interpret test results — its extreme clarity is a delight. On strings, complex orchestral or organ passages or any music the cartridge gives an effortless sound reproduction. It is difficult to avoid using superlatives to describe it. But of course at its price, the 1000ZE / X should be good. Recommended retail price is a cool $110.

Empire cartridges are available from retail outlets throughout Australia. Our sample came from the Australian distributors for Empire, Recorded Music Salon, 11 Collins Street, Melbourne, Victoria, 3000. (L.D.S.)

TRADE RELEASES — in brief

W. C. WEDDERSPOON PTY LTD, 193 Clarence Street, Sydney, 2000, has been appointed Australian distributor for Micro / Acoustics Corp, USA. Among the products initially available is a high frequency loudspeaker system designed to be added to existing speaker systems to improve the overall performance.

ASTRONICS A'SIA PTY LTD, 161-173 Sturt Street, South Melbourne, Vic 3205. Agent for Panduit Corp, USA. **Cable installation tool**, type Ty-Clip. This is a low-cost, lightweight hand tool used to tighten all Panduit miniature, intermediate, and standard cross-secton cable ties, clamps and markers. It also cuts off loose ends. The compact tool fits easily into a standard pool pouch. The new tool can also be used to remove installed ties, clamps and markers.

The Panduit Ty-Clip in use.

SCHLUMBERGER INSTRUMENTATION AUST PTY LTD, PO Box 138, Kew, Vic 3101. **Linear IC tester**, model TCL 232. Used with any standard oscilloscope, this low-cost unit will display the important parameters of linear ICs. Input bias current, offset voltage, and offset current are measured as a function of the common mode voltage, and the transfer characteristics may also be displayed. Various plug-in adaptors are provided to accommodate flat pack, dual-in-line, eight pin, and S packages. The adaptors include correction networks for most common linear ICs.

VARIAN TECHTRON PTY LTD, Springvale Rd, North Springvale, Vic 3171. Agent for Communications Transistor Corp, USA. **Power transistors**, D1-28 to D20-28 series. The D20-28 offers 20W from a 24 to 28V supply over the frequency range 400 to 1200MHz. It is the highest power device of a series of four transistors: other models are the 1W D1-28, the 3W D3-28 and the 10W D10-28. Other features include: single chip construction for maximum reliability; able to withstand infinite VSWR at all phase angles when operated at rated output and 24V supply.

AURIEMA (A'SIA) PTY LTD, 549 Pittwater Road, Brookvale, NSW 2100, has announced the return of its managing director, Mr E. E. Fawle, from a 2½-week visit to the USA. In New York, Mr Fawle discussed with Teledyne Isotopes the application of thermoelectric generators to the proposed natural gas pipeline between the Moomba gas fields in SA and Sydney. Mr Fawle also concluded negotiations with a new agency, Marantz Co Inc, manufacturers of quality consumer hi-fi equipment.

EMI (AUSTRALIA) LTD, 301 Castlereagh Street, Sydney, 2000. Agent for EMI Tape Ltd, UK. **Magnetic recording tape**, EMITAPE 816. This is a professional audio recording tape which offers extremely low noise and low print-through performance coupled with the advantages of a matt-coated back. It has a polyester base film with a specially treated coating which results in a substantial reduction in recording-head wear and an extremely low modulation noise characteristic. Features include: amplitude modulation noise level not greater than -38.5dB at both 15 and 7.5ips; at 15ips, the dynamic range is -74dB for 6.55mm mono track width and -70dB for 2.35mm stereo track width; the dynamic range at 7.5ips is -72.5dB (6.55mm track) and -68.5dB (2.35mm track). Signal-to-print level for both speeds is -58dB.

WARBURTON FRANKI PTY LTD, PO Box 182, Chatswood, NSW 2067. Agent for Societa Generale Semiconduttori (SGS), Italy. **Synchronous 4-bit binary counter**, type H 156. This latest addition to the SGS range of high level logic (HLL) integrated circuits brings the total to 14. A binary version of the decade counter H157, it features: asynchronous preset and rest; minimum fan-out of 25; operates from supply voltages from 10.8 to 20V; has DC noise immunity of 5V at 15V power supply. The H 156 consists of four master-slave J-K flip-flops arranged as a 4-bit binary counter.

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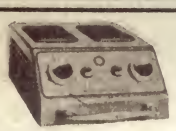

New All Silicon 30 / 60W PA PORTABLE AMPLIFIER

12-16V, two inputs, 5mV and 100mV. Dimensions 6½in W x 3¼in H x 8½in D. 15-ohm output, No 763D, $42. For 125, 250, 500-ohm output, No 763A, $44. For 240V operation $33 extra.
10W PA amplifier simliar to above, 4-ohm output, 240V operation, No 729D, $40. Freight extra.

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For EA (Fraser) circuit. Mounted on strong fibreglass printed circuit coded for all other components. Polyester film layer insulation. Connected and tested. For standard distributor, No 787; for photo cell distributor, No 786. $8 each. Postage 20c each.

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Peak reception. Low price. No expensive test equipment. Everything fits. 1964 RF Transporta 7.

Complete kit — No 640 $43.50
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(Write for booklet on 640 and 642.)

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SIZE 3 x 2 x 1in, 2 req. for stereo.

LOW IMP input, 2 trans, 672C	$6.50
Wired ready for use, 672D	$8.00
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Wired ready for use, 680D	$8.00
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No. 265 Universal tape Osc coil	$6.00

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HI-FI BROADCAST TUNER UNIT 4 TRANSISTORS—HIGH SENSITIVITY

RF mixer, IF, power detector stages, adjustable aerial coupling. Complete as illust, wired and tested with 461 dial, knobs and switch pot, No. 474D, $31. Freight extra.
WHISTLE FILTER for above set for 8KHz bandwidth. (Can be altered to 9, 10 or 11KHz.) No. 128, $4. Post 10c.

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MULLARD 10 + 10W RMS

With output transistor PROTECTION. Frequency response 40Hz to 30KHz. Distortion 0.5 per cent. Treble, bass boost, 20dB.

Complete kit of parts, No. 480C	$74.00
Wired and tested, No. 408D	$79.00
Cabinet as illustrated	extra $10.00
Magnetic pickup preamp, No. 762D	extra $11.50
Inbuilt BC tuner with w / filter	extra $35.00

Plus freight. Write for brochure. For special Saturday demo, ring 59 6550.

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Clearly coded for easy assembly. With blueprint parts list. Immediate dispatch. Add 20c postage for each. Specials to your drawings — write for particulars and drafting aids.

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777—70.F.10	772—70.G.7	759—70.C.1	$2.80
$2.00 ea.		776—70.A.2	$4.00
563—64.M.7	708—67.A.3		
579—64.A.8	709—67.P.4	717—68. P.1	639—65.T.3
683—64.A.9	711—67.A.4	741—69.P.5	727—68.8.T
678—65.O.9	723—68.5.T	747—69.C.10	728—68.O.9
679—65.M.9	731—68.M.12	746—69.P.9	
684—65.P.10	736—69.5.T	$3.00 ea. $3.20 ea.	
685—65.P.12A	750—70.A.1	SPECIALS	
769—70.K.60	756—70.R.1	734—59.O.1	74Z—69.C.9
686—65.P.12B	758—10.P.1	738—58.S.3	748—69.D.10
694—66.R.2	778—70.T.X.2	740—	754—69.C.11
704—67.P.2	792—E.T.003	68.10.CL	749—69.C.12
707—67.P.3			751—70.TX.1
$2.50 ea.		$5.00 ea. nett	

TRANSFORMER

Tap 6V and 9V at 100mA. Filter capacitors, rectifier, resistor, etc. $6.50. Post 20c.

NEW STEREO MAGNETIC PREAMP

Hum free, 5mV input, 250mV out. Size 3 in x 2in x 4in. Wired ready for use. No. 762D. $11.50. Post 10c.

NOISE FILTER for radio and TV

No. 27 line filter, 2A	$8.50
No. 29, 10A. No. 29B, 20A line filter	$35
No. 30 pulse filter, 2A	$11.50
No. 11 aerial filter	$13

Order direct. Pack and post 50c.

MAGNETIC STEREO PRE+AMP

In 5mV, out 250mV. Bass and treble 20dB.

No. 724C	$29
Wired ready for use	$31

Postage 30c each.

For crystal, ceramic, No. 722D	$27

NEW BASS BOOST 4-TRANSISTOR STEREO AMP

Unity Gain:
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100Hz, 5dB
50Hz, 9dB
30Hz, 14dB

Connect between your preamp and main amp. No. 791D, $10.80.
Postage 20c.

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780—70.P.A.1	$3.00
790—70.H.P.1	$3.00
783—71.T.U.2	$2.00
766—773—789—71.R.1	$2 ea.
796—71.S.A.4.A	$2.50
797—71.S.A.4.B	$2.50
798—71.S.A.4.C	$3.00
770—71.A.8	$2.50
812-71.P.8	$2.50

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TRADE BRIEFS — contd

FERRIS PRODUCTS DIVISION, Hawker Siddeley Electronics Ltd, 752 Pittwater Road, Brookvale, NSW 2100. **Portable car radio**, model 304. A 9-transistor receiver, the unit has been designed principally as a high performance car radio operating from a powered cradle, and removable for use as a battery operated portable. More compact than previous models, the 304 measures only 5·5 8 x 8·1 8 x 2·5 16in (14.3 x 20.6 x 5.9cm) and weighs 2lb (0.9KG). It features: tuned RF stage; 5in oval speaker; 3-stage permeability tuner; zinc diecast module for shielding; edge-lit dial; push-button on off, tone and aerial controls.

WRIGHT AUDIO DEVELOPMENTS, 3 Rowlinson Pde, Cammeray, NSW 2062. **AM tuner**, type LDT 3A. Intended for hi-fi reception, the tuner features: bandwidth to 20KHz ±0.5dB; very low distortion, 0.2% with 90% modulation; noise cancelling aerial; active 10KHz whistle filter with better than 40dB rejection; signal to noise ratio better than 50dB for 300uV input at 90% modulation; Sensitivity 10uV for 10dB signal-plus-noise to noise ratio; completely solid state, uses operational amplifiers throughout and a precise AC DC converter instead of a conventional detector.

PHILIPS INDUSTRIES LTD, GPO Box 2703 Sydney, 2001. **Sealing compound**, type PR 9258 00. This is a sealing compound for strain gauges which require protection in conditions of fluctuating relative

humidity. It is resistant to sea and other water up to about 400KG cm , can be stored at room temperature, and is simple to use. It is supplied in effectively pre-dried, 4 x 50mm strip form.

HEWLETT-PACKARD AUST PTY LTD, 22-26 Weir Street, Glen Iris, Vic 3146. **X-band doppler radar modules**, 35200 series. These are low-cost, solid state microwave devices that provide a means of detecting motion. A Gunn diode driving a resonant cavity provides RF energy, which is beamed to the moving object by a suitable antenna. Part of the energy is passed to the mixer as a reference signal. The moving target reflects part of the transmitted signal back to the antenna. The Hewlett-Packard unit eliminates the need for separate transmit and receive antennas by including a circulator at the output of the transmitter loop and the input of the receiver loop. The received signal passes to a mixer where it is combined with the reference signal to produce a frequency difference signal which provides a direct indication of the speed of the moving object.

FAIRCHILD AUST PTY LTD, PO Box 151, Croydon, Vic 3136. **IC voltage regulators**, 7800 series. These are available in three-terminal plastic packages and provide seven regulated voltages: 5, 6, 8, 12, 15, 18 and 24V. All the devices have built-in internal current limiting, automatic thermal shutdown, and safe area compensation to protect the device and the external circuit from excessive current, termperature and power fluctuations. Characteristics include: output voltage tolerance ±5%; line regulation 0.01% V; output impedance 30 milliohms; rated output current 1A, but up to 1.5A is possible depending on the regulation range, input voltage, and heat sinking used.

WATSON VICTOR LTD, PO Box 100, North Ryde, NSW 2113. Agent for Laybold, West Germany. **Basic physics kit.** This is a compact teaching kit, equally suitable for either the classical or modern approach to the subject, for use by non-specialist teachers in ordinary classrooms. It incorporates programmed learning and is complete with comprehensive teachers' notes.

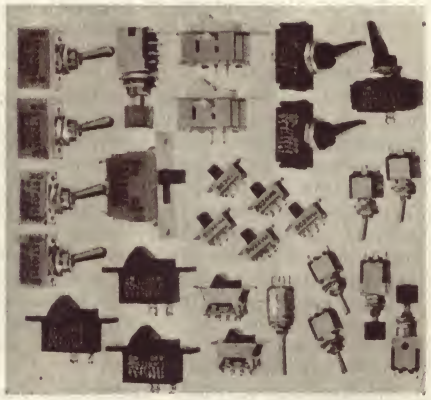
EAI-ELECTRONIC ASSOCIATES PTY LTD, 48 Atchison Street, St Leonards, NSW 2065. **IC audio amplifier module.** This is a 30W class B audio amplifier to complement the company's existing 15W device. The new device operates on a split power supply of ±15V to ±28V, and drives loads from 3 to 8 ohms. Characteristics include: input voltage 500uV; frequency response, flat from 25Hz to 25KHz; quiescent current 20mA; total harmonic distortion at 30W, 0.5% max, 0.15% typical; noise at 30W, -75dB typical; built-in overload protection. Price is $29 each in lots of 100.

PLESSEY COMMUNICATION SYSTEMS PTY LTD, 87-105 Racecourse Road, North Melbourne, Vic 3051. **Telephone**, International type. Suitable for all private telephone networks, the instrument features the dial located between the earpiece and mouthpiece

in the handset. Another unusual feature is a disconnect switch in the handset which allows dialling tone to be obtained at the end of a call without touching the switch hook. These features, plus an extra long, tangle-free handset cord, allow the base unit to be placed further from the user to reduce clutter on a desk.

ZETA LABORATORIES INC, 616 National Avenue, Mountain View, Calif 94040, USA. **Picket generator**, model 6050. This solid-state, high reliability device provides marker pulses having -33dBm minimum output levels spaced 25MHz apart over a frequency range of 250 to 1000MHz. It is suitable for system calibration or broadband local oscillator applications. The unit produces marker spacing to a frequency accuracy of 50ppm minimum, and is accurate to ±20ppm per year and ±2ppm per 10-minute period. Non-harmonic spurious signals are at least 50dB below the weakest marker signal. The unit is housed in a 4.5in x 1.6in x 1in (11.4 x 4.06 x 2.54cm) metal case and weighs 6.5oz (184G).

WARBURTON FRANKI PTY LTD, PO Box 162, Chatswood, NSW 2067. Agent for Fujisoku, Japan. **Low-cost switches, prototype pack.** This pack enables users to evaluate some of the more popular switches in the range of Fujisoku switches.



A sample of Fujisoku switches

FAIRCHILD AUST PTY LTD, PO Box 151, Croydon, Vic 3136. **Programmable read-only memory** (ROM), type 93406. This is a TTL device, fully decoded on chip and organised as a 256-bit by 4-word memory. The memory has open collector outputs that can be OR-tied with additional ROMs to expand word size. It offers a chip select feature which can be programmed as part of the customer's truth table: this allows the 93406 to be expanded up to 1024 four-bit words without external logic gates. The maximum access time is only 50nS from 0 to 75°C.

EMI (AUSTRALIA) LTD., Commercial & Advanced Electronics Division, 14 Parramatta Road, Homebush, NSW 2140, has been appointed Australian agent for Korting colour bar generators and comvergence test generators, used for the setting up and testing of colour TV receivers and colour video monitors.

BOOKS & LITERATURE

Radio control

RADIO CONTROL by Howard G. McEntee. Third edition. Stiff paper covers, 317 pages, 5¼in x 8½in. Published by TAB Books, USA. Price in Australia, $7.40. Hard covers $11.20.

This book appears to have stood the test of time. According to the preface, it first appeared in 1954 and this edition ran to five printings. Updated in 1961, the second edition ran to another five printings. This is the first printing of the third edition, published in 1971.

The chapter headings are as follows:

1 — Sequence Control Systems; 2 — Pulse Proportional Control Systems; 3 — Engine Speed Control; 4 — Expanding Proportional Systems; 5 — Multi-control Systems; 6 — Radio Control Servos; 7 — R-C Receivers; 8 — Transmitters & Licensing; 9 Keying the Transmitter; 10 — Batteries & Power Supplies; 11 — Relays; 12 — Test Instruments; 13 — Installation of Components; 14 — Adjustments & Tests; 15-Model Control Systems.

For anyone planning to enter the model control field, this book would seem to be a must. While giving some idea of the history and development of this subject, it will be found most valuable in putting the reader in the picture regarding contemporary practice, particularly in regard to the control systems, mechanisms, and the practical problems associated with them. In fact, as may be judged from the chapter headings, only chapters 7 and 8 are concerned directly with receivers and transmitters, with chapters 9, 12, and 14 less directly concerned. The other chapters deal mainly with control systems, involving both mechanical and electronic techniques.

In implying that the book is essential reading for the budding control enthusiast, we must emphasise that this does not mean that it is a complete answer to his problems. Through no fault of the author's but simply by reason of it origin, the book falls short of what is needed simply because it is written for the American market and the components which are available there.

Some of the components may be available on the Australian market, or equivalents, particularly transistors, may suggest themselves to those who have enough basic knowledge to analyse the requirements. Those who do not have this ability are likely to find themselves hopelessly confused. The situation is further complicated by the fact that a number of the transmitter and receiver circuits illustrated are based on kits available on the US market.

Similar remarks must apply to the sections dealing with licensing and available channels. The US requirements, while strict in most regards, are not the same as ours. If the difference is not appreciated, it may lead younger or inexperienced readers to believe that certain things are permissible in Australia, whereas they are not, and could bring the person concerned into conflict with the authorities.

Provided these shortcomings are appreciated, the book would be a valuable edition to any model control enthusiast's library.

Our copy from the Grenville Publishing Co Pty Ltd (P.G.W.)

Thermistors

ABC'S OF THERMISTORS by Rufus P. Turner. Hard covers, 96 pages 5½ x 8½ inches. Published by W. Foulsham & Co. Ltd, Slough, Bucks, England. Price in Australia $3.75.

Apart from Wein Bridge oscillators and germanium complementary-symmetry amplifier circuits, most electronics hobbyists would have little familiarity with thermistors and their many applications. Very few books have been written on the subject, so that ABCs of Thermistors is more than welcome. For the student and experimenter the book gives a simplified general coverage of thermistors. For the engineer or technician, it brings together a whole catalogue of applications, not available in other literature.

Chapter 1 is entitled "Thermistor Fundamentals" and gives a basic description of the behaviour of thermistors without delving into the complex semiconductor theory of operation. It goes on to catalogue the various thermistor configurations but does not mention the STC Brimistor device. This is mentioned in an introductory chapter for "the English readers". The chapter concludes with definitions of electrical ratings of thermistors.

The five remaining chapters describe applications. Chapter 2 is on instrument applications and shows the use of thermistors in thermometers, anemometers, flowmeters, altimeters, gas analysers and so on. Chapter 3 describes control and alarm applications. Chapter 4 details the conventional uses in amplifier and oscillator circuits. Chapter 5 is entitled, "Thermistors in Communications" and describes compensation of valve filament circuits, crystal oscillator stabilisation, uses in TV deflection circuits and miscellaneous transmitter and receiver applications.

Chapter 6, entitled "Supplementary circuits" concludes the book with circuits for temperature and voltage-controlled phase-shifters, amplitude modulators, a temperature-controlled neon oscillator and uses in DC / AC and DC / DC converters and battery charge control.

Altogether a very useful little book and one that most electronics hobbyists and technicians should not be without. Our sample came from Grenville Publishing Company Pty Ltd and copies will be available from all major bookstores. (L.D.S.)

ABCs of VDRs

ABC'S OF VOLTAGE-DEPENDENT RESISTORS by Rufus P. Turner. Hard covers, 96 pages 5½ x 8½ inches. Published by W. Foulsham & Co. Ltd., Slough, Bucks, England. Price in Australia $3.75.

In our review above on "ABC's of Thermistors" we state that most hobbyists will not be very familiar with thermistors. These remarks have even more weight when applied to voltage-dependent resistors, or VDR's, so this book by the same author is again very welcome.

Chapter 1 treats basic VDR theory and describes the various types available. The discussion is not confined to the conventional silicon carbide VDR which has a negative voltage coefficient of resistance, but includes other non-linear devices such as semiconductor and thermionic diodes (in their forward-biased mode), tungsten filament lamps, barreters and fuses. The author shows two symbols for the conventional VDR, one of which is identical to the symbol for the PNP semiconductor device, the Diac. He does state that the symbol in question is not often used nowadays for VDR's. Since the book was originally published in 1970 this must be regarded as an unfortunate error.

Chapter 2 describes the uses of VDR's in shunt regulator circuits. Many of these applications have now been taken over by zener diodes and gas-regulating tubes but the discussion is still relevant.

Chapter 3 describes applications of VDR's in amplifiers and oscillators. Signal compressors and expanders are mentioned but the author is careful to note that the AC response of VDR's can cause differing response to harmonics of an AC waveform.

The uses described in Chapter 4 may be more familiar to many readers as their application in TV deflection circuits is treated here. Also mentioned are their uses as screen voltage regulator in transmitter circuits, as lightning arrestors and frequency triplers.

The last chapter lists miscellaneous uses such as meter protection, expanded scale voltameters, transistor protection in square wave testing, harmonic intensifiers in oscillators and the VDR as a square-law element.

A very readable book and one that is sure to round out the knowledge of many technicians and hobbyists on a component which tends to be ignored in the flood of information on solid state devices. Our sample came from Grenville Publishing Company Pty Ltd and copies will be available from all major bookstores. (L.D.S.)

LITERATURE—in brief

SEMICONDUCTORS: TRANSISTORS, DIODES. This 48 page short form catalogue lists current "Miniwatt" semiconductor transistors and diodes with essential data and characteristics. Available free on application to Elcoma Division, Philips Industries Ltd, GPO Box 2703, Sydney, 2001. Applications should be accompanied by a 24c stamped and self-addressed envelope, not less than 9in x 12¼in, and should bear in the left hand top corner the endorsement "T D".

PLESSEY ROLA PTY LTD, Magnetic Materials Division, Browns Road, Noble Park, Vic 3174, has published an eight-page illustrated booklet which discusses the manufacture, properties and applications of the range of Alnico alloy permanent magnet materials produced by the company. The properties of each of the five alloys are fully tabulated, and the corresponding demagnetising and energy product curves are given.

TECHNICAL NEWS BULLETIN, Vol 55, No 10, October, 1971. Published by the US National Bureau of Standards. Contents include: Hot-hole electron cascades in field emission; The piezoelectric effect in polymers; 1972 W. D. George Memorial Award; Fortran program for arbitrary length arithmetic; Dissociation of gases by electron bombardment studied by JILA; Siped tyres no advantage on wet roads; Crystal filter narrows, stabilises dye laser output; NBS measurement seminars 1971-72 series; INCRA funds copper study; Defects in wire bonds; Simpler microwave power calibration; Computer program supplies figures for revenue sharing bill. Inquiries to the Superintendent of Documents, US Government Printing Office, Washington, DC 20402, USA.

TEKSCOPE, Vol 3, No 3. Published by Tektronix Inc, USA. Inquiries to Tektronix Aust Pty Ltd, 80 Waterloo Road, North Ryde, NSW 2113. Contents: The oscilloscope and transducer measurements; The new portables; Evaluating digital IC performance; Servicing the 7704 CRT circuit.

STANDARDS ASSOCIATION OF AUSTRALIA, 80 Arthur Street, North Sydney, NSW 2060, has published the following new Australian standards, available at the prices noted from the various offices of the association in all capital cities and Newcastle.

AS 1021. The design, construction and testing of enclosure of electrical equipment and associated parts to be used in flammable and explosive atmospheres (gas or vapour) without risk of fire or explosion. Price $1.60 each.

AS 1023. The conditions to be met by devices such as thermistors or thermostats built onto motor windings and sensitive to winding temperature as part of a system of thermal protection of electric motors, having a rating not exceeding 660V. Price $1.60 each.

AS 1114. A standard 7-bit coded character set for use in the numerical control of machines and associated equipment, and applying to any equipment for which a control procedure can be punched on an 8-track paper tape. Price $1 each.

The SAA has also issued Amendment No 2 to the 1969 edition of Part 1 of the SAA Wiring Rules. Copies may be obtained for 40c each.

FOILS FOR RESEARCH AND DEVELOPMENT. A catalogue and price list published by Goodfellow Metals Ltd, Ruxley Towers, Claygate-Esher, Surrey, England. It has 54 pages, gives over 2000 prices, lists 1000 foil items from 0.5 to 150um (microns). Intended for scientists throughout the world, it is printed in English, French and German, and includes a price conversion table so that prices can be read off instantly in the appropriate currency.

RF POWER TRANSISTORS. Published by RCA Electronic Components, USA. This gives essential data and characteristics for the range of RCA RF power transistors for operation from 2MHz to 3GHz, including two handy selection charts. Inquiries to Amalgamated Wireless Valve Co Pty Ltd, Private Mail Bag, Rydalmere, NSW 2116.

THE MICROPHONE. Vol 7, No 2, November December 1971. The journal of the Australian Tape Recording Society, PO Box 9, Crows Nest, NSW 2065. Contents include: Cutting your troubles in half; Audio — past and present; Imported goods.

AMATEUR BAND NEWS AND NOTES

by Pierce Healy, VK2APQ

AMSAT — its organisation and projects

The Radio Amateur Satellite Corporation (AMSAT) was formed in 1969 to provide amateur satellites and space experiments for the amateur service. Here are some interesting facts about it.

The December issue of the AMSAT Newsletter contained details of the Annual General Meeting and reports on past, current and future projects. Extracts from the newsletter give details of the extent and possibilities for the amateur service to participate in space research.

The officers of the AMSAT Corporation are:—

President: Perry Klein, K3JTE
Executive Vice-president: Jan A. King W3GEY
Vice-president Engineering: George Kinal K2MBE 3
Vice-president Operations: William A. Tynan W3KMV
Secretary: Charles Dorian W3JPT
Treasurer: Sheldon Glick WA1IUO

All officers are highly qualified engineers with a great deal of experience in space technology, telecommunications, international committees involved in the use of communication and navigational satellites and spacecraft testing.

In addition to their professional qualifications they have, as amateurs, been active in the organisation and administration of amateur radio societies in the US.

The AMSAT Corporation is affiliated with the ARRL. Membership at November 1971 was 461 including 41 societies and representing thirty countries.

Among past AMSAT activities has been the preparation and launching arrangements for Australis-OSCAR 5 in January, 1970. In recognition of that work, Jan King, W3GEY, received a NASA Special Achievement award.

In connection with the AMSAT-OSCAR-B project, two series of aircraft flights of a prototype translator were sponsored in 1971. The first was a series of checkout flights on 2nd and 12th May and a two-day flight on 15th-16th May in recognition of World Telecommunication Day (17th May). It is estimated that some 200 to 300 stations participated in that test.

The second series was on 28th August, 11th and 25th September. This was even more successful, and one station alone reported completing seventeen two-way contacts through the translator.

The main purpose of these tests is to help amateur operators prepare for operation with the AMSAT-OSCAR-B satellite and to gain technical and operational experience.

AMSAT provided much of the background material on amateur satellites to several of the delegations attending the ITU World Administrative Radio Conference on Space Telecommunications at Geneva during June-July 1971. It also advised the International Amateur Radio Union team which represented amateur radio at the conference.

At that conference a new "Amateur Satellite Service" was defined and made provisions for amateur satellites to operate in the 7MHz, 14MHz, 21MHz, 28MHz, 144MHz and 432MHz bands as well as a new band 24GHz to 24.05GHz.

In the education field, AMSAT provided several lecturers for a University of Hartford graduate workshop. This was planned to assist teachers to use amateur satellites as an educational tool for teaching science and physics.

Co-authored with members of the WIA-Project Australis Group, AMSAT members presented a paper, "Spacecraft Telemetry Systems for the Developing Nations" at the IEEE National Telemetering Congerence in Washington in April 1971. Material was also provided for expanded Space Communication Sections of the 1972 ARRL and RSGB Handbooks.

Currently, AMSAT-OSCAR-B satellite is being readied for possible launch during 1972. The prototypes and flight units of the following sub-systems have been completed: the 24 channel Morse telemetry system developed by W5CAY; the 432MHz to 146MHz ten-watt linear translator developed by DJ4ZC and DJ5KQ in Germany: the two to ten meter linear translator built by WA4DGU, W4RUD and K3JTE: the 35-function command system provided by WIA-Project Australis, and the instrumentation converter provided by W3GEY.

In addition, prototypes of the WIA-Project Australis 146MHz to 435MHz FM repeater and 60-channel teletype telemetry encoder were completed. A breadboard of CODESTORE, a Morse code message storage device was constructed. This is designed to store emergency messages, operational information on the satellite and orbit information, for repeater transmission to the ground stations. Work is also proceeding on flight and flight-backup hardware and on the solar cell and wiring harness assemblies.

In February, 1971, NASA advised AMSAT that it will undertake the launch of A-O-B, and it now appears most likely that A-O-B will ride piggy-back with the ITOS-D meteorological satellite into a planned 1500KM. polar obrit. The United States FCC has notified AMSAT that they would waive certain American regulations as they apply to A-O-B, and would permit US Novice and Technician Licensees to operate through the two-to-ten meter translator.

Two years ago AMSAT submitted a proposal to NASA to provide amateur experiments for the ATS-G Applications Technology Satellite in 1975. This proposal has been recently amended and AMSAT has now proposed a SYNCART (Synchronous Amateur Radio Translator) experiment for ATS-G. It is proposed to provide, at no cost to NASA, a 146MHz-to-435MHz 20 watt linear translator for integration into the NASA ATS-G spacecraft.

ATS-G is planned for geostationary (synchronous) orbit and will contain a 30 foot parabolic reflector available for the SYNCART experiment, providing a rare opportunity for amateurs to use a synchronous satellite on a regular basis with a modest amateur equipment.

SYNCART is designed to demonstrate the usefulness of the amateur satellite service in providing emergency communications, educational training, and experiments with small terminal multiple-access communications.

Another proposal recently submitted to NASA, is to provide, at no cost, 10 metre SSB equipment for SKYLAB-A, NASA's manned orbiting laboratory scheduled for launch in 1973. The project, named SKYLARC, (SKYLAB Amateur Radio Communications), is designed to encourage the use of space techniques by amateurs, while providing the opportunity to communicate with astronauts during their spare time.

In addition, SKYLARC could provide emergency backup communications for the astronauts, who will be out of contact with NASA tracking stations for periods as long as ninety minutes. SKYLARC is also expected to have useful educational applications.

At the NASA Goddard Space Flight Centre, Manned Spacecraft Centre and Marshall Space Flight Centre AMSAT members have been actively assisting with the project. Dr Owen Garriott, W5LFL, one of the astronauts in training for SKYLAB has indicated his interest in participating in SKYLARC activity.

SKYLAB-A is planned for a 430KM circular, 50 degree inclination orbit expected to bring it within range of most amateurs around the world. The use of the ten meter band would enable widespread participation using readily avallable amateur equipment.

From the foregoing it will be seen that AMSAT is at present involved in three major projects through the mid 1970's. A-O-B, expected to be launched during 1972, has a planned lifetime of one year. SKYLARC, if accepted, would be expected to be launched, about April 1973 and last until the end of 1973.

SYNCART, if approved, can be expected to fly on the ATS-G satellite around 1975, and last until 1978, or even later.

In his report, at the annual meeting, Perry Klein, K3JTE, expressed the hope that these three projects will bring about new achievements for which all amateurs can be proud.

To enable more persons to follow AMSAT activities, a new net was inaugurated. It will meet on the second and fourth Sundays of each month on 14.280MHz SSB at 1800 GMT (4.00am EAST.(

Application for AMSAT membership should be made to — Radio Amateur Satellite Corporation, P.O. Box 27, Washington, D.C. 20044 USA.

Membership fee is $5.00 (US) per year.

DEFINITIONS

The terms "transponder", "repeater" and "translator", when referring to equipment used to retransmit a received radio signal, have led to some confusion. This fact was brought to the attention of Bob Clark, WB4SMH, editor of the AMSAT Newsletter.

In the editorial of the December issue, Bob gave the following definitions:—

Transponder: This is the most all-inclusive term, including both the repeater and translator discussed below. Any device which transmits a signal when it receives a signal which it is designed to accept is a transponder. The transmitted and received signals need not resemble each other.

Repeater: This transponder does just what the name says. It repeats what it receives. It need not repeat the received signal at the same radio frequency.

Translator: This is a repeater which changes the radio frequency of the signal before retransmitting it.

All three A-O-B equipments could be called transponders, repeaters or translators, however, in the terms of the above definitions they should be called translators.

Bob's quip on the definition is — "In my nightmares I see some amateur calling me up to say: "This translator you've got on A-O-B . . . can I use it to talk to JA's even though I can't speak Japanese and they can't speak English?' "

Oh the vagaries of the English language!

A-O-B Education Net Proposal

A recommendation has been made by Sheldon Glick, WA1IUO, that a 50-State high frequency net be formed, meeting once a week or more often after the AMSAT-OSCAR-B launch. This would provide a means of coordinating A-B-O experiments and active project participation by a sizable number of stations.

The proposal is that at least one station be located in each state; perhaps more in larger states. A list of these, including addresses and telephone numbers, would be published in QST, distributed to every participating school, and perhaps published in educational journals. A teacher anywhere in the country could contact the nearest station to set up an experiment or communication schedule with any other school in the country.

Amateur stations could use the net in the same way, and it could be extended to include other countries as well. The large number of stations involved would provide redundancy so teachers would contact a station in a neighbouring state if the local station was, for some reason, not in service or temporarily unreachable.

Example 1: A teacher in Chicago wishes to run an experiment on orbit No 644 with a participating school in Miami. Both schools are equipped to use the AMSAT 2-10 meter translator. The Chicago teacher would contact the local net station at least a week in advance of the desired orbit giving all details. On the next net meeting the information would be transmitted both to the South Florida net station and to a command station at Talcott Mountain Science Center.

The school in Miami would be notified by the local net station. The Command Station would make sure that the proper translator is turned on for orbit No 644 and also load a message into codestore of any temporary change to be made in spacecraft status for orbit No 644 (i.e., switch off translator in service) far enough in advance to notify other users of the

Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent direct to Pierce Healy at 69 Taylor Street, Bankstown, NSW 2200.

change. Example 2: A NASA space mobile at Austin, Texas, wishes to demonstrate changes in the skin temperature of the spacecraft during orbit No 1067 to a teacher workshop. They contact a net station one week in advance of orbit 1067. The appropriate command station is notified on the next net meeting and on orbit 1067 the spacecraft is commanded to telemeter only the desired parameter.

The suggestion has many interesting possibilities and although the examples illustrated are centred on the USA, they could be adapted for other locations.

In Australia, the WIA Youth Radio Club Scheme would be very fertile ground for such activity. Other Australian teaching institutions could benefit greatly by participating in experimental projects similar to those outlined. It is suggested that consideration be given by the WIA to organise in Australia and New Zealand experimental projects along these lines.

Moonbounce Experiments

Ray Naughton, VK3ATN, who has been carrying out moonbounce experiments on UHF and VHF for several years, started 1972 on a high note. Two two-way 144MHz contacts were made on 1st January.

The first contact was with Michael Staal, K6MYC, in San Jose, California, USA and the second with Lionel Edwards, VE7BQH, in North Vancourver, Canada. The contact with K6MYC was at 1142 GMT to 1150GMT on 144.005MHz and with VE7BQH from 1150 GMT to 1158GMT, on 144.004MHz. CW was used in both cases.

The equipment used by Ray consisted of a stacked Rhombic antenna which has been in operation for several years. The transmitter uses a single 4CX250 and the receiver a simple converter using a 6CW4 pre-amp. Ray explained that a transistorised converter was not used, mainly due to the fact that the sky noise is around 2.5dB to 3dB and there is no advantage going below that figure.

The converter was followed by a heterodyne mixing unit and a 28MHz IF with suitable noise blankers. A 2.1KHz bandwidth filter was used, which was broader than the one normally used.

Several visitors present when the contacts were made were impressed with the signals received. They had a beautiful view of the rising full moon while the contacts were in progress.

Business commitments are preventing Ray from spending much time on various building and experimental projects he has in mind. Therefore, he cannot give any information on his future activities.

Novice Licences

Since the original recommendations of the WIA Novice Licensing Investigation Committee were published in the July, 1971 issue of these notes, further work has been done by the committee. A considerable amount of material was received from groups and individuals interested in the proposals. In fact a far greater number of letters, petitions and verbal opinions were received than prior to compilation of the original report.

However, submissions favoring the introduction again greatly exceeded those opposing such a move. The strongest support came from radio clubs which are conducting training courses for the AOCP and persons situated in remote country areas away from clubs and other licensed amateurs.

The supplementary report by the committee made the following recommendations regarding matters for negotiation with the Postmaster-General's Department:—

a. That the PMG authorities be asked to approve a trial period of five years during which a lower-level licensing scheme should be operated and, at the expiration of that period, an assessment should be made of the value to the amateur service and to the public interest.

b. That of the various suggested schemes for an amended licensing structure, preference should be given to that which involves three grades of amateur transmitting licences.

c. That the suggested name of the proposed certificate should be "The Amateur Operator's Restricted Certificate of Proficiency" and should, therefore be indicated by the abbreviation "AORCP".

d. That suggestions involving the use of radio telephony for "Restricted" licensees should be discarded and that the original proposals of "CW only" should be maintained.

e. That there should be no limitation or tenure for "Restricted" licensees.

f. That a distinctive range of call signs be suggested for identification of "Restricted" amateur stations, such as VK3RAA to VK3RZZ.

g. That "Restricted" licensees should be permitted to operate as fixed, portable and mobile station operators.

h. That the original suggestion regarding the submission of character references by applicants should be deleted.
i. That proposals for the use of VHF bands by "Restricted" licensees should not be accepted.
j. That the listing of suggested frequencies for "Restricted" operation, as indicated in Appendix C of this supplementary report, should be used as a basis for negotiations with the Postmaster-General's Department.

Recommendations for action by the Wireless Institute of Australia.

a. That in the event of a "Restricted" licensing scheme being introduced, each division should devise means whereby such amateur operators could be assisted, encouraged and further instructed to higher amateur status.
b. That "Restricted" licensees should be permitted to hold Full Membership of the Institute.
c. That "Restricted" operators should be encouraged in the activities of the Key Section.

Appendix A:

Proposed amended conditions for the award of Amateur Operators Restricted Certificates of Proficiency.

1. That the candidates must pass Morse code receiving and sending tests at an equivalent speed of FIVE words per minute.
2. That candidates must pass a written examination in Regulations as for AOLCP and AOCP candidates.
3. That candidates may gain "conceded" passes for the "Restricted" Certificate by gaining between 50 and 60 per cent of the possible marks in the AOCP Theory examination.
4. That candidates for the "Restricted" Certificate must conform to the same age requirements as for AOLCP and AOCP candidates.

Appendix B:

Proposed transmitting privileges for holders of "Restricted" certificates.

1. Ten Watts input to final stage of transmitter(s).
2. Crystal control.
3. CW operation only.
4. No time limit for holding "Restricted" licences.
5. Operation permitted under fixed, portable and mobile (passenger-operator) conditions.
6. Frequency allocations approved by the Postmaster-General's Department for the listing in Appendix C.

Appendix C:

Proposed amended frequency allocations for use by holders of "Restricted" certificates.

1. 1805KHz to 1855KHz
2. 3525KHz to 3570KHz
3. 7025KHz to 7065KHz
4. No operation on 14MHz band
5. 21.03MHz to 21.15MHz
6. 27.00MHz to 27.20MHz
7. 28.10MHz to 28.50MHz
8. No operation above 28.50MHz.

Many hours were spent discussing and reviewing all points raised by those persons who expressed their views either for or against the introduction of such a scheme.

The committee consisted of, Rex Black, VK2YA chairman; Pierce Healy, VK2APQ; Keith Howard, VK2AKX; Dave Jeanes, VK2BSJ and Kev Watson, VK2BLW. They were unaminious in the view that the scheme as proposed would benefit that section of the community interested in radio communication, the Wireless Institute of Australia and amateur radio in general.

QCWA

The Quarter Century Wireless Association meets on the second Wednesday each month at the Combined Services Club Barrack Street Sydney. At the January meeting arrangements were discussed for the meeting and entertainment of several overseas visitors who will be visiting Sydney in the near future. Membership is open to amateur operators of 25 years standing or more. Further details may be had from Harry Caldecott, VK2DA, Brian Anderson, VK2AND and Pierce Healy, VK2APQ at their call book addresses.

Trans-Equatorial Propagation

From mid March 1972 until mid-April 1972, the Ionospheric Prediction Service will be operating a Trans-Equatorial Propagation warning system. Up to 45 minutes warning will be given of the occurrence of trans-equatorial phenomenon, on 6815KHz SSB.

VHF operators looking for 52MHz contacts with Japanese stations should monitor 6815KHz. Remember the IPS will be pleased to receive details of contacts made together with any unusual band conditions that may be observed. Report forms may be obtained from the Ionospheric Prediction Service, 162-166 Goulburn Street, Darlinghurst, NSW 2010. See January notes for example.

WIA ACTIVITIES

The thirty-sixth federal convention of the Wireless Institute of Australia will be held in Melbourne over the Easter Weekend April 1st to April 4th 1972. Agenda and general business items covering matters which members think should be discussed should be sent to divisional secretaries early in March.

A major change has been made in the method of payment of yearly subscriptions. The membership registers of all divisions have been computerised in Melbourne and renewal of subscription notices have been mailed from the Federal Executive office. Subscriptions must now be sent to — WIA, P.O. Box 67, East Melbourne, Victoria 3002. After amounts payable to Federal Executive have been deducted the balance will be remitted to the appropriate division.

It is expected that the Electronic Data Processing of Institute records will result in a reduction of costs. Similar savings are anticipated in the preparation of mailing lists and the Australian Call Book data.

NEW SOUTH WALES

The Annual General Meeting of the NSW Division will be held on Friday 24th March 1971 8pm. Business will include the election of council for the coming year, the annual report and treasurer's report.

The Annual Dinner will be held at the Artarmon Bowling Club on Saturday evening 25th March. Accommodation is limited to seventy persons. Booking may be made and other information obtained from the Administrative Secretary, 14 Atchison Street, Crows Nest. Telephone 43 5795. The annual field day is set down for Sunday, 26th March, probably in the St George district area. As these notes went to press the program or venue had not been finalised.

VICTORIA

Geelong Amateur Radio — TV Club

The January Newsletter of the Geelong Amateur Radio — TV Club gave some interesting details of 52MHz activity. A report from Phil Fitzherbert, VKOPF, at present stationed at Casey Bane, Antarctica, states that on 6th January 1972, he worked WB5DYJ, KC4 at McMurdo Sound, 1,200 miles away. Signals were RST 559. CW was used. Phone was useless due to auroral flutter.

A report was also received of reception by UA1KAE 1 at the USSR Base Molodezhnays, a distance of about 1,200 miles in the opposite direction. Unfortunately two-way contact could not be made as USSR stations are not permitted to use 52MHz.

The club's study group resumed work on each Friday night commencing at 7pm. Full details may be obtained from Alan Bradley, VK3LW telephone Geelong 59-2811.

Meetings are held every Friday night at the Club Rooms, Storrer Street, East Geelong. Visitors are welcome. Postal address is P.O. Box 520, Geelong, Victoria 3220.

WIA YOUTH RADIO SCHEME

It was very pleasing to receive, late in January, a letter from Reverend Bob Guthberlet, the Federal Supervisor of the Wireless Institute of Australia Youth Radio Club Scheme, expressing his appreciation of the publicity given to the YRCS in "Electronics Australia" per medium of these notes.

Bob reports that a conference of YRCS supervisors from all States is to be held during May 1972.

Two important items will be discussed at the conference i.e., ratification of a YRCS constitution, and uniformity in the study notes for the YRCS certificates.

Another point expressed by Bob is that it is his aim to resist any attempt, however feeble, to dissociate the YRCS from the WIA.

Having been instrumental in "selling" the Youth Radio Scheme, on behalf of the NSW Division, and the founder, Rex Black, to the Federal Council at the 1962 Federal Convention in Perth as a WIA project, the author finds the above sentiments particularly gratifying.

It is pleasing to look back over the past decade and know that, despite the efforts in 1967-68 of a determined group to reject the scheme as a WIA project we still have a sound and progressive activity linked with the WIA. An activity that is a service to the community and is held in high regard in industrial and communication circles.

YRCS Correspondence Section

The supervisor of the YRCS Correspondence Section Bill Tremewen, VK3ZCI, reports that 1971 was another successful year. Despite a slow start, membership at the end of the year equalled the previous record of 110.

The recent increase in postal charges has considerably added to the costs, but the fees for 1972 will be the same as in 1971 (i.e. $4.00 per annum).

Members of the Correspondence Section gained 63 certificates during 1971. Of these, two were at senior level, five intermediate, eleven junior and fourty-five were at elementary level. The year saw a change in examiners, as Geoff Post, VK2BGP, was forced to resign due to family and business commitments. Geoff and his wife Lyn spent many hours as examiners. The new examiner is Murray Burford, VK5ZQ, assisted by his wife Pamela.

Any young person who wishes to learn about radio as a hobby, but is unable to join a suitable Youth Radio Club, is invited to become a member of the Correspondence Section. Further details can be obtained from the Secretary, Marian Tremewen, 34 Flower Street, Fern Tree Gully, Victoria 3156.

Maitland Radio Club

During the Christmas recess members of the Maitland Radio Club carried out further work on the Club premises at Maize Street, Tenambit, East Maitland. Among the tasks completed was the lining, painting and furnishing of the administration office. Library facilities were improved and sound equipment circuits installed in the theatrette projection room.

The club resumed its activities on Friday 27th January. It will begin its training program by providing five classes a week.

These will include two classes a week for beginners, one junior class, one intermediate and the AOCP class for advanced members preparing for the PMG examinations to be held in August 1972 and February 1973.

The elementary classes will be conducted every Friday and Tuesday nights at 7pm. New members are welcome and can begin their training immediately.

Annual membership fees of the club are $3.00 for adults and $2.00 for junior members. No knowledge of radio is necessary.

Social activities arranged by the club include film evenings for members families and friends and record parties for junior members and their friends.

Ten members who received training in radio at the club have gained employment in the electronics field. The latest two, Gary Watson and Neil Gibson, have begun training with the PMG's Department in Sydney as telecommunications apprentice tradesmen.

Full details of the club's activities can be obtained by writing to the Secretary, Mrs M. Watson, P.O. Box 54 East Maitland. NSW 2323.

St George Amateur Radio Society

A five man committee comprising the president, vice-president, secretary, treasurer and education officer will in future deal with routine administration matters of the club, supplying an abridged report to members at general meetings.

To assist in the exchange of information on technical subjects relating to radio and television, a technical question time has been introduced at the monthly meetings of the club. Members are invited to bring along their questions for discussion.

The proposed club "Newsheet" is still under consideration. The recent increase in postal charges and rising costs are difficulties to be overcome.

Noel Ericsson, VK2MF, education officer, advised that he is preparing a register of members interested in joining the Civil Defence communication roster. Also that to assist the Ionospheric Prediction Service to obtain information relating to VHF propagation, log sheets and other details are available from him.

In a recent issue of Scouting News, appreciation was expressed to members John Lambert, VK2AKQ, Hal Lindoy, VK2ASL, Phil Watson, VK2ZPW assisted by Andy Vanderdonk and John Flaherty for providing amateur radio station equipment and manning three stations in the Boy Scout Jamboree-on-the-Air. Some 53 Scouts, 36 Girl Guides and 53 visitors participated in local and overseas contacts with other scouting groups.

At the Training Annex, 17 McIntyre Avenue, Brighton Le Sands, the visual trainer has been programmed for the YRCS Elementary Certificate classes held on Monday nights at 7pm and the Junior Certificate classes held at the same time on Tuesday nights.

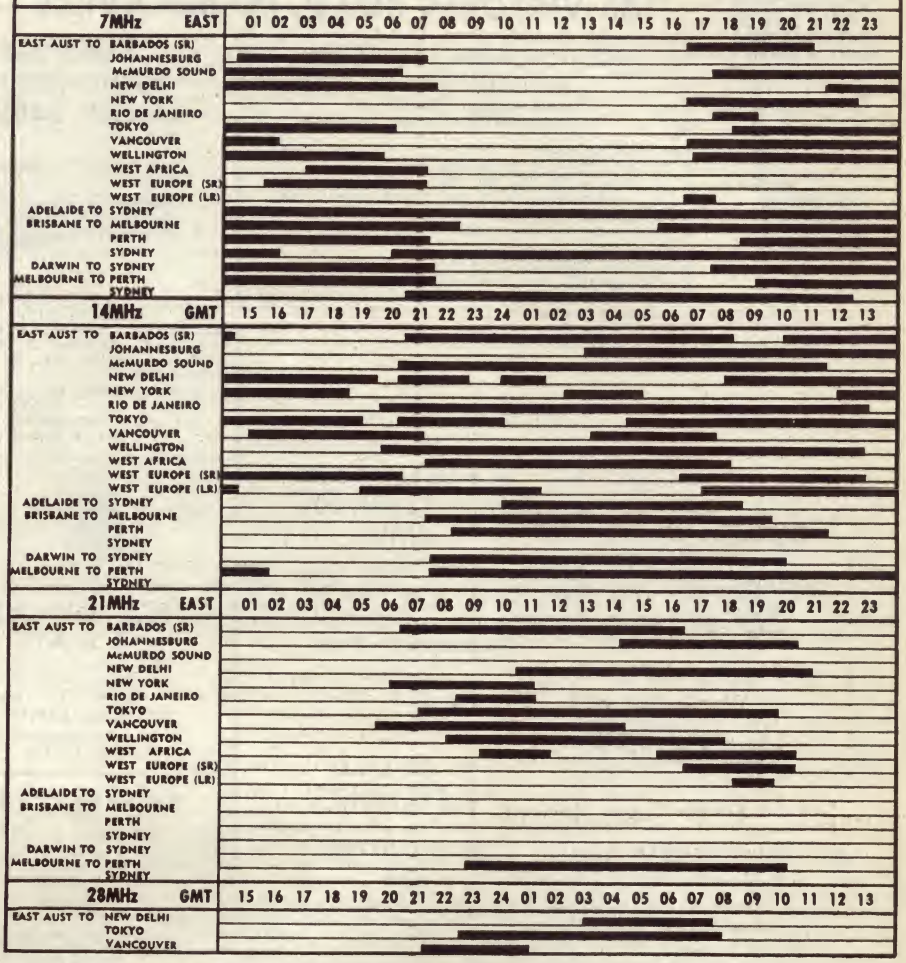
Registration for these courses should be made by telephone to 59 1658.

Preparations are also being made to incorporate Morse code training classes in the educational courses. Application has been made for a station licence to enable on air practice to be given to students and members holding limited licences.

The society meetings are held at the Civil Defence Hall, The Mall, South Hurstville on the first Wednsday of each month, 7.30pm.

IONOSPHERIC PREDICTIONS FOR MARCH

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Commonwealth Bureau of Meteorology. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). They have been prepared for the four most popular amateur bands over a number of interstate and international circuits. Black bands indicate periods when circuit is open. 3.72



"It was a cold February morning, about 2am. I was tuning around the 20-metre band — I hear this chanting — sort of Arabic — there was just a slight heterodyne. Slowly I adjust my antenna tuner . . ."

("Electronics Illustrated")

SONATA
GUITAR AMPLIFIER

Sonata guitar amplifier or self-contained portable P.A. system. 3 models. 15-20-35 watts RMS 240VAC operation. Four high impedance inputs suitable for Mic-P U guitar. Two channels with independent volume controls. Bass and treble boost controls; vibrato tremelo separate speed and intensity controls; remote vibrato on off foot switch, complete with lead and plug. 15 and 20 watt models have two 8" twin-cone heavy duty wide-range speakers. All models are supplied fitted in black vynex covered carry cabinet. 15 watt $80.00. 20 watt $94.00. 35 watt $129.00.

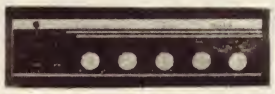
50 WATT SOLID STATE GUITAR AMPLIFIER

E.A. July and August issue.
Kitset, including cabinet.
$98.00
Wired and tested.
$114.00

MUSICOLOUR II

As per E.A. Dec. '71, Jan. '72. Complete kits of parts $49.50
Fully constructed $59.50
Pack & post 75c
P.C. BOARD ONLY $3.25
SPECIFIED TRANSFORMER ONLY $4.35

ALL SILICON TRANSISTOR SOLID STATE STEREO AMPLIFIER



240V AC powered, 8 watts RMS per channel inputs for magnetic ceramic, and crystal cartridge, also recorder and radio tuner. HI-FI frequency response speaker matching 4-16 ohms. Size 10½ in x 6½in x 3½in. Attractive oiled teak cabinet.

$54.00

15 watts per channel deluxe version of the above amplifier with the added feature of 8-ohm stereo headphones.

$67.50

BELT DRIVE HI—FI STEREO RECORD PLAYER

4-pole synchronous motor, 45 33rpm. 12-inch die-cast turntable. Fully-balanced pickup. Magnetic cartridge, diamond stylus. Auto return. Cueing device. **$89.00**

HI-FI STEREO HEAD PHONES

Freq. 20-12000 Hz
Imp. 8 ohms
Complete with lead and standard stereo phone plug.

$5.25
Pack and post 35c

STEREO RECORD PLAYER

240V AC — 4 speeds, ceramic cartridge. Separate motor, 7in turntable, pickup arm and rest. Post 50c.

$7.90

Mounting platform available, $5.50. Post 40c.

MAGNETIC CARTRIDGE

Response: 15Hz — 25000Hz
Output: 9mV
Diamond Stylus.
Tracking weight: 1-2.5 grams

$9.60

STEREO RECORD CHANGERS

C109 — C116 — — C117 — C117A3

Current models, 4 speeds, automatic or manual operation.
Standard model **$28.50**
Ceramic cartridge, Sapphire stylus.
Standard model with 12in turntable **$34.00**
Deluxe model with 12in turntable, Cueing device, ceramic cartridge, diamond stylus **$40.00**
Deluxe model as above with — adjustable counter balance, 2 spindles, calibrated stylus pressure control added **$46.50**
Deluxe model as above with 12in Diecast Heavyweight turntable, 4-pole shielded motor, sutiable for Magnetic cartridge **$56.50**

The latter two record-changers can be supplied with magnetic cartridge and diamond stylus at $10 extra

B.S.R. STEREO RECORD PLAYER

Latest design. 4-speed. Auto or manual operation. 11" heavyweight diecast turntable driven by fully shielded 4-pole dynamically balanced 240V motor. Noise suppressor. Silicone damped cueing device. Square section brushed aluminium pickup arm. Adjustable counterbalance. Calibrated stylus pressure control. Antiskate bias compensator fitted with magnetic cartridge. Diamond stylus.

$62.50
Pack and post $1.50

CHANGER AND PLAYER PLATFORMS

Teak. Cut out to suit C109-MA65-MA70-MA75 **$9.00**
Fully moulded tinted perspex cover, 17¼in x 13½in x 4in **$9.00**

$9.00

CASSETTE TAPE RECORDER

Solid state, 2-track mono. Piano key push controls. Slow-fast speed adjuster. Rim drive. Supplied complete with microphone with remote switch, cassette tape, batteries, earphone, instruction book, circuit.

$28.75 Post 75c.

Rotating Distress Emergency Beam

Red, Blue, Amber
—Visibility ½ mile.
12V DC operation. Waterproof. Complete with heavy duty suction Cap. Size 3½in. dia. x 5½in.

$5.75.
Pack and Post. 35c

GARRARD STEREO RECORD PLAYER

3 Speeds, Auto-Stop Sonatone HiFi Ceramic Cartridge included.
$15.50

Pack and Post NSW $1.00.
Pack and Post Interstate $1.50.

MAGNAVOX WIDE RANGE TWIN-CONE SPEAKERS

8-16 ohms
30-16000 Hz.
6WR MK5 12-W RMS $ 9.90
8WR MK5 16-W RMS $10.75
10WR MK5 16-W RMS $11.50
12WR MK5 16-W RMS $12.50

Pack and Post 65c.
Send SAE for Data Sheet.

SINCLAIR INTEGRATED HI-FI AMPLIFIER

Z30-20 Watts $12.00
Z50-40 Watts $14.50

All Instructions and Circuits Supplied.
Pack and Post 50c.

TAPE CASSETTES

Tensilised Mylar Supplied with Plastic Pack.
C60 95c
C90 $1.80
Head Cleaner $1.70
Post 10c

Special. American Robbins Tensilised Mylar.
7" 2400 FT. $5.50
Post 25c

TOP QUALITY AUST. MADE SPEAKERS

12in Woofer 20 watts RMS $24.25
12in Woofer 15 watts RMS $22.00
12in Twin-cone 15 watts RMS $19.00

15" PIONEER

15in Pioneer low frequency speaker, Imp. 8 ohms. Power, 30 watts, RMS designed especially for use with bass guitar or electric organ. Also ideal for stereo woofer speaker.

$33.00

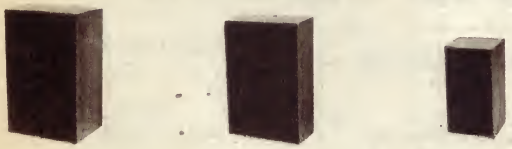
ROLA 50 WATTS RMS

Model 12U50
12" Speaker

Frequency response 25Hz — 11kHz. 8 or 15 ohms.

$35.00

SPEAKER ENCLOSURES



NEW MAGNOVOX 8.30 SYSTEM
Ref. Jan. '71 E.A.
1.6 C.F.T. 30 watt, 8.6 ohms.
Complete ready for use.
$60.00 ea.
8-30 speaker only **$18.50**
3TC Tweeter only **$3.75**
Cabinet only **$30.00**

HI-FI SYSTEM with 8WR MKV and 3UC tweeter
16 watts, 8-16 ohms, 22in x 14in x 8in.
$43.75 ea.
Hi power system with MSP 12UAX and 2MBC tweeter. 23½in x 17in x 12½in. 20 watts **$53.75 ea.**

FAMOUS MULLARD MAGNAVOX **Bookshelf enclosures** 6WR MKV and 3UC tweeter, 8-16 ohms, 15½in x 8¼in x 8½in.
Complete ready for use.
$26.75 ea.
Cabinet only **$13.95**

All cabinets are constructed of Pineboard and veneered with oiled teak Formica and are complete with cross over network — tweeter — Innerbond packing.

LISTENING AROUND THE WORLD

by Arthur Cushen, MBE

Radio Bangladesh broadcasts reported

Many of our readers have reported hearing the former East Pakistan radio station at Dacca broadcasting as Radio Bangladesh.

During the India-Pakistan conflict, the Radio Pakistan transmitters at Dacca were silenced, but soon returned to the air as Radio Bangladesh, after the cessation of hostilities. The reception on short-wave has been best on 15520KHz with an English program of news at 1230GMT. A short announcement in English has been observed at 1205GMT. Radio Bangladesh is not a new name as far as listeners in the Dacca area are concerned, as a clandestine station operated on medium-wave 830KHz with this slogan for some months prior to the India-Pakistan conflict. The station was put back on the air in January and operates on the following schedule.

GMT	KHz
0100-0300	690, 1170, 9850
0700-0900	690, 1170, 9425, 15520
1300-1600	690, 1170, 9425, 9850

News in English is at 0215, 0740, and 1415GMT, and is of 10 minutes duration. News in Bengali is at 0130, 0730 and 1300, each also of ten minutes duration, while bulletins of 5 minutes each are at 0250, 0850, and 1545GMT.

Medium-wave stations are also operating in Bangladesh. The medium-wave network consists of Chittagong 870, Rangpur 1050, Rajshahi 1080, Sylhet 1140 and Khulna 1340KHz.

RECENT VERIFICATIONS

PAPUA-NEW GUINEA: Many readers have heard Radio Medang on 3260KHz, but verification cards received from the station have given no information as to its location. Noel Parry of Invercargill, NZ, has received a letter, which states that verifications being issued by Joseph Goahan of the Administation Broadcasting Station are for reception of Radio Medang. These cards were postmarked "Jomba"; this is a suburb of Medang.

INDONESIA: Radio Republik Indonesia, at Djajapura, has confirmed our reception on 6070KHz with a letter in English. The letter stated that the broadcast we received was transmitted during testing of a new 20KW transmitter. The letter stated that no schedule was available, as the transmitter was still under tests. This letter was signed by Soedarsono.

RADIO NACIONAL VENEZUELA

Radio Nacional Venezuela commenced test transmissions on 30th November, and will be the official voice of Venezuela. The transmitters, located near Caracas, are operating on 9550, 11725 and 17840KHz; with 500W. They are also testing new transmitters on 11725, 11750, 11770, 11970, 15390, 15400 and 17840KHz. "Sweden Calling DX-ers" reports that the station has been heard at various times between 1900 and 0630GMT. The address of the station is PO Box 3979, Caracas.

We first verified Radio Nacional when on 6170KHz, using the call sign YVKO and the power of 10KW. The new transmitter has been assigned the following calls and frequencies: YVSC, 9640KHz; YVLS, 11725; YVRN, 11750; YV—, 11770; YVKI, 11970; YVRO, 15390; YVKN, 15400; YVRP, 17840.

MADAGASCAR ON 15260KHz

The Radio Nederland relay station at Madagascar recently commenced transmissions on a test basis with two 300KW transmitters. A new frequency of 15260KHz has been used from 1400 to 1520GMT, for tests to South Asia. This channel replaced 15330KHz because of interference from All India Radio on the adjacent frequency, and from the USA's Armed Forces Radio Service, which is using 15330KHz for transmissions from Bethany, Ohio.

The test consisted of light music with taped announcements asking for reception reports to Radio Nederland, PO Box 222, Hilversum, Holland, and offering special Madagascar verification card.

LIBERATION RADIO

Liberation Radio of South Vietnam has been heard on the new frequency of 9920KHz, with English news and comment at 1030GMT. This frequency is actually announced as 10010KHz. The English broadcast, of 15 minutes duration, is also broadcast on 7490KHz.

The station recently verified our reception with a letter and several newspapers. The verification came from The Voice of Viet-nam, 58 Rue Quan sir- Hanoi. The 1972 World Radio Handbook gives the address as 39 Avenue Georges Mandel, Paris 16e, France.

MEXICAN SIGNALS

Mexican station, XEBR, which was heard consistently for many years on 11820KHz, has returned to the air on an irregular basis. We first heard XEBR many years ago when it was using only 150 watts, and they verified reception with a card showing a map of Mexico. The station has been heard at various times recently with a program of Latin American popular music.

XERMX Radio Mexico, Mexico City, no longer announces 21705KHz, but continues to use 9705, 11770 and 17835KHz. Best reception is on 17835KHz. The station address is now Apartado 20-620, Mexico 20.

KGEI USES 9745KHz

Station KGEI in San Francisco, California, has been heard on the new frequency of 9745KHz to closing at 0500GMT. The station has been using several frequencies for Latin America, and in recent months has been received on 9670 and 9715KHz. The new frequency of 9745KHz is giving fair reception, but suffers from interference.

For many years HCJB in Quito, Ecuador, has used 9745, but has relinquished this frequency up to 0700GMT. They are then heard on this frequency in a service to the South Pacific. Radio Sweden uses 9745KHz from 0515-0615GMT for a program to Australia and New Zealand.

TAHITI WELL RECEIVED

It is a year since Radio Tahiti was first reported on 15170KHz. This signal is proving to be the most reliable for reception around 2200 and at 0300GMT in Tahitian, and at 0500GMT in French.

The present schedule is:

Sundays: 1900-2330 and 0300-0800GMT (1900 French, 2045 Tahitian, 2140 French, 0300 Tahitian, 0500.

Other days: 1615-1830, 2100-2330 and 0300-0800GMT (1615 French, 2030 Educational program in French, 2100 Tahitian, 2145 French, 0230 Educational program in Tahitian, 0300 Tahitian, 0500 French).

The frequencies and powers used are 15170KHz (20KW); 11825KHz (20KW); 6135KHz (4KW); 3223KHz (4KW); 740KHz (20KW).

TEST FROM CEYLON

Radio Ceylon, at Colombo, has been heard by Frank Aue of SA, testing to Europe on 21445KHz with a transmission in English and German. The station was also heard on 17830KHz. Broadcasts on 21445KHz are 0700-1130GMT, and on 17830KHz 1200-1600GMT.

AUSTRIAN RADIO CONTINUES

There was some concern at an announcement last year that Austrian Radio was to be closed due to insufficient funds being made available by the Government. Many listeners throughout the world, particularly those who are members of the Radio Canada Short-wave Club, wrote to Vienna asking for the continuation of the service. The listeners expressed concern at the closing of the station. Because of its musical programs, it is ranked high by short-wave listeners.

On November 8, 1971 the Austrian Government signed an agreement with Osterreichischer Rundfunk (ORF) which came into effect last January 1, by which financial agreements covering a number of years will permit the external service to continue, even perhaps to enlarge on its existing programs.

UGANDA RADIO EXPANSION

The President of Uganda, General Idi Amin Dada, recently opened a new 100KW medium-wave broadcasting transmitter at Butabo in Uganda.

This station is the first of four being built to provide nation-wide coverage for medium-wave listening in Uganda. All four stations are bing equipped with pairs of Marconi 50KW transmitters operating in parallel. The Marconi contract also includes the supply and erection of aerial towers, and the installation of a small studio at each station for broadcasting regional programs in conjunction with the national network.

SWAZI RADIO

Further news about a new station for Swaziland is contained in the Canadian DX Club's "Hello DXers", which states that an American company is installing a medium-wave and short-wave transmitter. The station will transmit in English 0455-0010GMT on 1376KHz and in the 60-. 49-, and 25-metre bands. It will identify as "Swazi Radio".

For many years Swaziland has operated only on the broadcast band. When in South Africa, we heard their transmissions on 881KHz on a regular basis from Johannesburg. The station had mainly local announcers, some commercials, and relayed the BBC news on a regular basis. The station was operated by the Swaziland Broadcasting Service from Mbabane. It is expected that the new station, which will carry commercial programs, will also provide good reception throughout most of South Africa.

RADIO ULAN BATOR

According to "New Zealand DX Times Radio", Ulan Bator, Mongolia, broadcasts in English 1220-1250GMT on 17780, 17860KHz, and 2200-2230GMT on 11810, 11860KHz. French language programs are broadcast 2000-2030GMT on Tuesday, Wednesday, Friday and Saturday on 15120 and 15160KHz. Other languages used are Russian, Chinese, Khazakh and Mongolian. The transmitters have an output of 25KW and 50KW, and a rhombic antenna is used. Announcers are trained in Mongolia and the USSR.

PROPAGATION COURSE

Radio Nederland will broadcast a short-wave propagation course in its weekly program "DX Juke Box" from March 9, 1972. Printed texts are available with details of the times and frequencies of the broadcasts from DX Juke Box, c / o Radio Nederland, PO Box 222, Hilversum, Holland.

BROADCAST BAND NEWS

MALDIVE ISLANDS: Radio Gan, a station operated by the British Forces, is on 1215KHz with 25 watts. The station verified a listener in Ceylon who heard a broadcast around 1800GMT. Radio Gan recently began broadcasting on FM with 1KW, and requests reports to BFPO 180, London GPO, England.

PHILIPPINES: Station DZCH is now being heard widely in Australia on 1600KHz. Harry Weatherley, of Mt Waverley, Vic, reported reception at 1300GMT, and has received a verification letter. DZCH is one of several stations owned and operated by the National Council of Churches in the Philippines. DZCH operates 2100-1600GMT with 10KW, according to W. G. Watterson. Chief Engineer.

FLASHES FROM EVERYWHERE

AUSTRIA: The Austrian Army Radio has transmitters in Vienna and Salzburg, reports "Sweden Calling DX-ers." Vienna transmits Monday-Friday 1100-1300, Monday 1600-2000; Salzburg schedule is Monday 0500-0700, Monday, Tuesday, Thursday and Friday 1600-2000. Code lessons are 1100-1130 and 1700-1730. Both transmitters use 6255KHz. The address for reception reports is Gussriegelstr 45, 1102 Vienna or PO Box 50711 Wals Salzburg.

GREAT BRITAIN: BBC frequencies cover the 75 to 11 metre bands, and from time to time new frequencies are added. During the Queen's Christmas message three new frequencies were used by the BBC for the first time. These where 6045, 11875, and 15135KHz, which were heard at 0900GMT on December 25.

SINGAPORE: Radio Singapore is using the transmitter of the British Forces Broadcasting Service which closed a few months ago, reports Sweden Calling DXers. English news at 1530GMT is heard on 5010KHz.

NEPAL: Radio Nepal is presumed to have made a frequency change from 4600 to 4980KHz. The station has been heard on this frequency with English news at 1500GMT followed by a program in Nepali, which included commercial announcements.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, New Zealand. All times are GMT. Add 8 hours for WAST, 10 hours for EAST, and 12 hours for NZ.

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ANSWERS TO CORRESPONDENTS

COLOUR TELEVISION: I would like to see your magazine discuss the advantages and disadvantages of colour television operation on the VHF and UHF bands, as well as the design of colour receivers using integrated circuits. A question that arises, is that relating to X-ray emission due to the high voltage used in colour television receivers. Will the Government legislate to control this potential danger? (B.C., Fairfield, Vic.)

We are of the opinion that the time is not yet ripe for design articles along the lines which you have suggested, as there has not been any decision made as to the date when colour television is to be introduced into this country. The United States recently went into the matter of X-ray radiation and all manufacturers have been cleared on this score. We imagine that a similar procedure will be adopted here when the time comes. As to the relative merits of VHF and UHF, such a discussion is hardly pertinent in regard to Australian conditions at the present time. Existing VHF TV stations will simply change over to colour when the time comes. There is no suggestion of moving to the UHF bands, nor is there likely to be any until the existing channels prove inadequate to cover all populated areas; this will probably not happen for a long time.

CDI INTERFERENCE: I recently constructed and installed the CDI system described in the Aug 1970 issue of Electronics Australia and am having very good results with it except for prominent radio interference. Fraser states in the article that there is no need to fit suppression devices or leads, but I find to the contrary. I find that there is less interference with TVRS leads than with solid conductor cable, and that the spark is reduced to an equivalent level of the conventional Kettering system. Can you explain the reason for this, and could a suitable filter be placed in circuit to reduce RF interference without degrading the CDI spark in any way? (G.L., Sunnybank, Qld.)

The experience of our own staff members and others is that there is normally lower RF interference from CDI systems than from conventional ones. However, one reader reported a similar co... on to yours and the suggestion was made to insulate the system from the body of the vehicle and take the common return to the same lug to which the battery chassis connection was made. The idea was to minimise circulating currents which could have been creating the problem. This proved to be completely effective in his case. Either lumped resistive suppressors or TVRS resistive ignition cable may be used if it reduces the problem, the latter being the more effective. In fact neither will have any adverse effect on the ignition quality of the spark. It does change the appearance of the spark, but this is no indication that it has impaired its ability to ignite the fuel. "Fatness" of a spark is not a measure of its effectiveness.

In general, it merely indicates the duration of the spark, all else being equal. A spark can have more energy, as from a CDI system, yet can appear "thinner" than a lower energy one, as from a Kettering system, because of its shorter duration. We doubt whether there is any filtering system, such as you envisage, which would have any beneficial effect.

CDI SYSTEM FOR MOTORCYCLE: I would like to know if your CDI system published in the Aug 1970 issue is adaptable to a dual ignition Suzuki T500R motor cycle. Does this setup require two separate CDI systems, or can the one system serve a dual purpose? (M.T., Wellington, NZ).

With an arrangement of two trigger circuits similar to that of the "Hot Seat" (Nov. 1971), the one storage system of the Aug 1970 CDI system could be used with a dual system motor cycle. Care would have to be exercised in the layout to prevent interaction between the DC-DC converter and trigger circuits, and between the two trigger circuits themselves. As we have no plans to publish details of this rather specialised system, we cannot enter into discussion of any problems that may be involved.

TRANSISTOR EQUIVALENTS: I have read a lot of foreign electronic journals and have experienced difficulty in locating various semiconductor devices or their equivalents to construct several projects. Is there a book or pamphlet available anywhere that covers transistor equivalents such as these? I also wish to compliment you on a very high standard of magazine, and find articles of consistent interest. I feel that "Listening Around the World" is a feature which surpasses any monthly foreign publication. (R.S., Nedlands, WA.).

Thank you for your comments, R.S. about the magazine and "Listening Around the World". Unfortunately, we do not know of any semiconductor equivalent listings or pamphlets of overseas semiconductor devices other than the D.A.T.A. international one or perhaps those that may or may not be available from the various manufacturers. The D.A.T.A. system is not a cheap one, and is available only on a subscription basis — far out of the reach of the hobbyist who may only use it a few times a year. An alternative for the hobbyist is a transistor substitution guide which was reviewed in the "Technical Books and Publications" section of the Sept 1971 issue under the title "Direct Transistor Substitution Handbook". Readers who require such a publication are directed to this review for full information.

SIMPLE RECEIVERS: Could you send me a circuit diagram of a crystal set and of a three, four or five transistor radio. (S.L., Kogarah, NSW.)

We have published a number of articles which may meet your requirements. An article published in July, 1969 described simple crystal and transistor sets (File No 4/TR1/11). In March, 1968 we published the "FET Three" receiver (4/TR3/3) followed in April, 1968 by a version of this receiver using plug-in coils to allow it to be used for SW reception (4/TR3/4). We published a "Simple Receiver of Novel Design" (4/TR4/3) in November, 1966 using four transistors, and we published a Mullard design for a cordless mantel receiver using five transistors (4/TR5/1) in October, 1961. Copies of the article mentioned may be obtained through the Information Service for 50c each.

ELECTRONIC ORGAN: Would you please advise me if copies or reprints of the articles describing the Stromberg-Playmaster organ are still available. (D.P., Middle Park, Vic.)

Copies of the articles (Files Nos 1/EM/1 to 9 inclusive) are available through the Information Service for 50c each. ($4.50). However, as this project was

"ELECTRONICS AUSTRALIA" INFORMATION SERVICES

As a service to readers "Electronics Australia" is able to offer: (1) Project reprints, metal work dyelines, photographs, printed wiring patterns and other filed material to do with constructional projects and (2) A strictly limited degree of assistance by mail or through the columns of the magazine. Details are set out below:

PROJECT REPRINTS: These cost 50c per project. Prior to December 1959, circuits and diagrams only are available. From December 1959 onwards, complete articles are available. No material can be supplied, additional to that already published. Reprints can be supplied more speedily if they are positively identified and not accompanied by technical queries. Material not on file can normally be supplied in photostat form at 30c per page.

SUBSCRIPTIONS, BINDERS, HANDBOOKS etc: These are handled by seperate departments. For fastest service, send separate orders to the departments concerned.

PHOTOGRAPHS, METAL WORK DRAWINGS: Original photographs are available for most projects. Price: $1 for 6in x 8in glossy print. Metal work dyelines are available for most projects. Price: $1 These show dimensions and positions of holes and cut-outs, but give no wiring details.

PRINTED WIRING PATTERNS: We can supply negative transparencies, actual size. Price: 50c. We do NOT deal in manufactured boards. These are available from advertisers.

BACK NUMBERS: As available. On issues up to six months, face value. Seven months to 12 months, face value plus 5c. Thirteen months or older, face value plus 10c. Postage and packing, 10c per issue extra. Please indicate if a PROJECT REPRINT may be substituted if the complete issue is not available.

REPLIES BY POST: These are provided to assist readers encountering problems in the construction of our projects published within the last two years. Note, particularly, that we cannot provide lengthy answers, or undertake special research or modifications to basic designs. Charge: 50c. Inclusion of an additional fee does not entitle correspondents to special consideration.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee and may be answered in the magazine at the discretion of the Editor. Technical queries will not be answered by interview or telephone.

COMMERCIAL EQUIPMENT: "Electronics Australia" does not maintain a directory of commercial equipment, or circuit files of commercial or ex-disposals equipment etc. We are therefore not in a position to comment on any aspect of such equipment.

COMPONENTS: "Electronics Australia" does not deal in electronic components. Prices, specifications etc should be sought from appropriate advertisers or agents.

REMITTANCES: These must be negotiable in Australia. Where the exact charge may be in doubt, we recommend submitting an open cheque, endorsed with a suitable limitation.

POSTAGE & PACKING: All charges shown include postage and packing, unless otherwise specified.

ADDRESS: All requests for data and information should be directed to the Assistant Editor, "Electronics Australia", Box 2728, GPO Sydney, NSW, 2001 — (10/71)

developed in late 1961, you may experience difficulty in obtaining some essential components. We are therefore no longer recommending this project for construction.

HELP WANTED: I have been reading "E-A" since it was born in 1939, and it is tops in its class. I have only missed a few issues (1941-45), but even the old issues are worth reading. I have a favour to ask of you or your older readers, concerning a piece of ancient equipment used in the 1920's. It was called a loose coupler, and consisted of two coils, one sliding in and out of the other on two brass rods. I wish to build one for a project, but have no details. Perhaps one of your readers may have such details, so will you please publish my full name and address. (Mr. S.G. Carter, 15 Campbell Ave, Normanhurst, NSW 2076.)

Thank you for the compliments. As you can see, we have published your name as requested. Any readers able to help can contact Mr Carter direct.

MOVIE SYNCHRONISER: There must be many movie-high fidelity enthusiasts who would appreciate your producing a synchronising circuit based on the pulse principle. How about an indicator system as per the enclosed pamphlet, or something similar. I have three of your Vari-Light controllers. Is there a solution to the unpredictable interaction when using them in fairly close proximity, ie, on stage? Also are any of your noise silencers suitable for use in the power line to the stage PA? (R.G.D., Tarragini, Qld.)

A member of our staff is currently researching the movie problem along similar lines to those you have indicated. However, it is not easy to do the job well, and it promises to be a complex project. At this stage we can make no promises as to when we will complete the project and publish our results. If you wish to experiment with the idea, the outlines of the system you propose appear quite sound and research along these lines should produce satisfactory results.

We have not previously encountered any interaction between Vari-light controllers. One possible solution to your problem may be to use the Vari-watt (File No. 2 PC 4) published in January, 1966. This is basically the same as the Vari-light, but includes supression components. Our latest power line filter (File No. 2 LF 5), published in June, 1971 with an addendum in August, 1971, may be suitable for your PA system.

Incidentally, you have not given us your full name and address, so we are unable to return the pamphlets to you, some of which are originals, if you require them, and care to advise us, we will be happy to return them.

TRANSISTOR RF AMPLIFIER: Have you a circuit for a two-transistor RF amplifier that could be made from salvaged parts. (D.P., Long Jetty, NSW.)

We have published two articles describing transistor RF preamplifiers, both of which used FET devices — which are unlikely (as yet) to be available as salvaged parts. The first (File No 2 SW 48) was published in May, 1969; the second in July, 1970 (File No 2 SW 53). Copies of the articles may be obtained through the Information Service for the usual 50c each.

1966 OSCILLOSCOPE: I intend building the 1966 CRO. I have only the May 1966 issue. Are there any corrections for this project? Is the layout very critical? Could the layout be spread over a larger area in a larger case? Would the CRO be suitable for TV servicing? My compliments on a fine magazine. (G. J., Perth, WA.)

Errata for the 1966 Oscilloscope were published in the August and September 1966 issues. We do not recommend altering the layout of any of our projects. If you feel competent to tackle this, by all means go ahead. However, we cannot enter into any discussion concerning any possible results. We would consider this CRO suitable for TV service work. Thank you for your kind remarks about the magazine.

FREE TRANSISTOR: I want to thank you for the transistor you sent. Grandfather gave me a diode and I got my first sounds through the phones. Now I can make it sound better. Grandpop helps me a lot. (A.H., Moonah, Tas.)

It was a pleasure to give away those transistors to young enthusiasts like yourself. We hope that many more are bitten by the electronics bug. It is a fascinating hobby.

TUNNEL DIODES. In the November, 1959 issue, you published an article on the tunnel diode. Have you published anything since then? Are there any books about their use, where can I get them, and at what price? If they were so outstandingly wonderful as your 1959 article suggests, why have we not seen more about them? (C.R., Rockhampton, Qld.).

Since the tunnel diode was invented, it has taken its place among the many other solid state devices as a component useful in specific applications. One often sees reference to their use in professional equipment as very fast acting switching devices, but they have very little application to equipment intended for home construction and have not been featured very much in our own projects. However, the tunnel diode was discussed in Chapter 6 of our series "Fundamentals of Solid State", published October, 1969. This article is available through the Information Service for 50c (File No 8 FSS 6); or if you would like the whole series, we have republished them in book form, and this is available through the Information Service for $2.30 posted. Information on other books available should be sought from technical booksellers.

LEAKAGE CHECKER: After reading through the article on the "Leakage Checker for Capacitors", I was wondering if you intended publishing an insulation tester along the lines of a "Megger" in a future issue? (W. W., Brisbane, Qld.)

We considered the "Megger" idea for the Capacitor Leakage Checker, and concluded that a "go, no-go" indicator lamp was all that would be required. Although the capacitor checker can be used in the same way as a megger, it lacks an indicating instrument. At this date, we have no plans for adapting the capacitor checker to an electronic "Megger", as there appears to be very little interest in such a project.

MULTIMETERS: I read the article "Understanding Multimeters" (Modern World Electronics, Electronics Australia, September 1971) with so much interest that I bought a multimeter — not the one described but a more expensive one — and have found it both interesting and useful. The article does not go far enough, however, as it does not explain how to use the decibel scale. Could you publish a follow-up article on this subject in the near future. (A.M., Aspendale, Vic.)

We are glad you found the original article so stimulating. We will certainly consider your suggestion about an article describing decibels and how to measure them.

SELECTING A STEREO SYSTEM. I am in the process of selecting a stereo system but I have only a marginal knowledge of the quality of various brands. I envisage a separate amplifier of about 10-15W per channel; a pair of 10in loudspeakers, and a player deck. For this I would be prepared to spend about $250. Can you recommend any articles or publications which would help me to get the best value for my money? (B.E., Moss Vale, NSW.)

An article "Choosing an Amplifier" was published in the August, 1971 issue, and a reprint of this can be obtained through the Information Service for 50c. This contained a discussion on the general requirements for a good quality stereo amplifier, plus a listing of those available in Australia with performance data, prices if available, and names and addresses of distributors. We have not published a survey of loudspeakers, nor one for turntables. In view of your limited budget, we suggest you consider building a set of one of the loudspeaker systems described in "Electronics Australia". The Magnavox 8-30 system described in the January, 1971 issue provides an excellent standard of performance for a modest outlay. Since your budget will of necessity restrict your choice of turntable to one of the lower priced units, we suggest you plan your system on the basis of a good quality ceramic cartridge, rather than trying to use a magnetic cartridge in a budget priced turntable. The superior frequency response of a magnetic cartridge at the bass end will tend to reproduce to a greater extent the inherent rumble of the turntable mechanism. With a ceramic cartridge, this problem is not nearly so severe.

SPEAKERS: Could you please explain what quadraphonic means, and send me a circuit. Does an eight ohm, eight inch speaker need more power to drive it than an eight ohm, three inch speaker. Could you tell me why it is necessary to connect an eight ohm resistor or another speaker across the output of an amplifier to get high impedance headphones to work across it, too. Is there any difference between impedance and resistance? (D.W., New Town, Tas.).

Quadraphonic is a term given to recorded music which is recorded on four channels and comes from

NEW RH (Radio House) RANGE OF MULTIMETERS

MODEL RH-60 $25.00. Postage 50c

50,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 25uA, 5mA, 50mA, 500mA.
Resistance: 10K, 100K, 1M, 10M.
Decibels: —10 +62dB.
Accuracy: DC ±3 p.c., AC ±4 p.c. (of full scale).
Batteries: Two 1.5V dry cells. Overload protected.

MODEL RH-100 $39.75. Postage 75c

100,000 Ohms per Volt DC 10,000 Ohms per Volt AC

• Overload protected by dual silicon diodes • Double-jewelled ± 2 per cent meter • ± 1 per cent temperature-stabilised film resistors • Polarity changeover switch • Mirror scale • Instructions for operation with circuit diagram.

SPECIFICATIONS:

DC Volts: 0.6, 3, 12, 60, 300, 600, 1200 (100,000 V).
AC Volts: 6, 30, 120, 300, 1200 (10,000 V).
DC Current: 12A, 300A, 6mA, 60mA, 600mA, 12 amps. AC Current 12 amps.
Resistance: 20K, 200K, 2M, 20M.
Decibels: —20 to +17, 31, 43, 51, 63.
Accuracy: DC ±3 per cent. AC ± 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

MODEL RH-20 $13.95. Postage 50c

20,000 Ohms per Volt DC.
10,000 Ohms per Volt AC.

Specifications:

DC Volts: 0.25, 2.5, 10, 50, 250, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current, 50uA, 25mA, 250mA.
Resistance: 7K, 700K, 7M.
Decibels: —10, +22 (at AC/10V) +20, +36 (at AC/50V). Upper frequency limit 7KHz.
Batteries: Two 1.5V dry cells.
With overload protection $15.00.

MODEL RH-55 $20.00. Postage 50c

30,000 Ohms per Volt DC
14,000 Ohms per Volt AC.

Specifications:

DC Volts: 0.6, 3V, 12V, 60V, 300V, 1200V
AC Volts: 12V, 60V, 300V, 1200V.
DC Current: 60uA, 12mA, 300mA.
Resistance: 10K, 1M, 10M.
Decibels: —10dB, +23dB.
Overload protected.

MODEL RH-80 $18.00. Postage 50c.

20,000 Ohms per volt DC.
10,000 Ohms per volt AC.

Specifications:

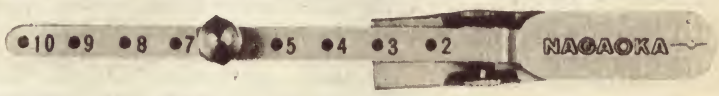
DC Volts: 0.5, 2.5, 10, 50, 250, 500, 1000.
AC Volts: 10, 50, 250, 500, 1000.
DC Current: 50uA, 5mA, 50mA, 500mA.
Resistance: 5K, 50K, 500K, 5M.
Decibels: —10dB + 62dB.
Accuracy: DC 3pc.
AC 4 per cent (of full scale).
Batteries: Two 1.5V dry cells, size AA, "Eveready" 915.

• Overload protected by dual silicon diodes • Double-jewelled ± 2 per cent meter • ±1 per cent temperature-stabilised film resistors • Mirror scale.

$9.50 Posted

As featured in Electronics Australia October 1971, the two-station Edison Intercom.

STYLUS PRESSURE GAUGE, Balance type NW-501



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RADIO HOUSE PTY. LTD.

306-308 PITT STREET 61-3832 26-2817 760 GEORGE STREET SYDNEY. 211-0171

four speakers; usually there are two front and two rear. It gives the impression of being "surrounded" by the orchestra, etc. For more information, refer to the articles in February & October 1970, and April 1971. It is not true that a larger speaker needs more power to drive it. Rather, the reverse applies. As speakers get larger, they become more efficient, and are able to be driven from smaller signals. They are also able to handle more power. Without knowing specifically what you were trying to do with your headphones, we cannot give a specific answer. However, we will assume that you have tried to connect a pair of headphones to an amplifier and found that they did not work. The most likely reason would be that the headphones were of a type (crystal) which do not provide a DC path, and that the output stage of the particular amplifier required this path in order to function. In a more general sense any amplifier will need a correct value of load in order that it will function correctly plus, in many cases, a DC path through the load. If the speaker is removed it is usual to replace this with a resistor of similar value, and to connect the headphones across it. (Refer. Stereo Headphone Adaptor, December 1969, File No. 1/MS/7.) There is a difference between resistance and impedance, but it is far too involved to go into here. Refer to chapters 1 & 3 of our "Home Study Course" (May & July 1971). Briefly, it may be said that resistance is a fixed measure, but impedance is dependent on frequency.

MAGNAVOX LOUDSPEAKERS: Can you tell me if the new Magnavox loudspeaker system can be driven by 7W per channel? (J.Y., Frankston, Vic.)

We assume you are referring to the Magnavox 8-30 loudspeaker system described in the January, 1971 issue, and that you are asking whether 7W per channel is sufficient to provide adequate volume in a normal domestic situation. An output of 7W per channel would be more than adequate under such conditions.

TECHNICAL BOOKS: Can you send me a list of technical books available on the following subjects: Electronics; TV and Servicing; Computers. Have you a branch in Melbourne? (C.B., Lavington, NSW.)

The only books published by "Electronics Australia" are the following:

Basic Electronics
An Introduction to Digital Electronics
Fundamentals of Solid State.

These are available through the Information Service for $2.00 each, plus 30c postage. We are not in a position to provide lists of text books from other publishers. Such information should be available from the major technical booksellers. The addresses of our interstate offices are shown on page 3 of each issue.

TRANSCEIVERS: Have you published, or do you intend to publish, circuits for miniature transceivers, such as used in television studios. I intend to use these for communication between two people over short distances. (D.K., Prospect, SA.)

We doubt whether we can help much D.K. The only type of transmitting equipment which we normally describe is that intended for use on the amateur bands. The main reason for this is the difficulty and expense of obtaining PMG approval for home-made equipment, for use on frequencies other than those assigned to licensed amateurs. Of necessity, the specifications laid down by the PMG's Department are very tight, particularly in regard to spurious radiation. If this was not so, poorly designed transmitters could cause havoc on other channels. Since very few home constructors would have access to test equipment having the facilities and precision necessary for this task, there is little point in encouraging them to build equipment which would almost certainly be rejected by the Department. Incidentally, it is a serious offence to operate any form of transmitter without the appropriate licence, permit, or approval of the PMG's Department. Contravention of the law can be punished by a heavy fine and or jail sentence, plus confiscation of the equipment.

AUTOCHARGER: On page 60 of the October 1971 issue, you described an automatic battery charger designed to deliver 4 amps. Do you have a circuit of the same type which delivers 10 or more amps on charging? What components are necessary to convert the present one to a 10 amp unit? (M.H. Mentone, Vic.)

It would be necessary to conduct a redevelopment of the present circuit for higher current capacity, M.H. To accommodate the extra demand, a "professional" type of thyristor would no doubt be used (which would have an accompanying "professional" price tag), along with other more costly components. However, we have filed your request, and if feasible, a new design may appear when the time can be spent on such a unit.

DATING THE SPINE: I have purchased your magazine since June 1959 and always look forward to receiving and reading each issue. I would like to make a suggestion which I believe would increase the value of the magazine, particularly for those like myself who file them for reference but cannot justify binders. This is to print the date and year of each issue along the spine of the cover, between the staples, so that it may be picked out easily from the bookshelf. Could this be done? Best wishes for the future. (T.L., Arncliffe, NSW.)

We agree that this would be a good idea, T.L., and although we foresee possible mechanical difficulties, we will see if it can be done. Thanks for your compliments regarding the magazine.

CRO AND GENERATOR: Congratulations on an excellent magazine. I would like to know if you have any intention of publishing plans for a Square Wave Generator or a CRO in the near future. (G.P. Newport, Vic).

Thank you for your kind remarks about the magazine. We have described a number of CROs and square wave generators in past issues, but have no

(Continued on Page 125)

SOUND PROJECTORS
Cinevox Prefect and Harmour and Heath 16mm in good working order. 240v operated, complete with speaker and amplifier.
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3¼in diameter. Will do the same work as the conventional slide rule. Instruction book included.
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Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line.
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240 volt AC Input .
Each battery Charger will charge either 6 or 12 volt batteries.
2 amp without meter **$15.75**
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MINIATURE ELECTRIC MOTORS
1½ to 3 volts DC. Ideal for model boats, cars, planes, etc. Strong torque. Only
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TRANSCEIVER
(2-way radio) R.C.A. America RT 68, 24 volt, operated 10 watt output 38-54MHz F.M. crystal locked. Transmitter and receiver using frequency synthesiser in 100KHz; step 10 channel per MHz with power supply, mike, and headphones. $45. 60c. cartage to rail. Freight payable at nearest attended railway station.

TRANSCEIVER
(2 way radio) 62 set, 12V, operation. Ideal Hams, etc. 1.6 to 10MHz. Crystal locked or VFO controlled. 5 watt output. Complete with antenna, headphones and mike. $60. 30c. cartage to rail. Freight payable at nearest attended railway station.

HEADPHONES
Low Impedance moving coil fitted with rubber muffler to reduce external noise, fitted with press to talk, dynamic hand microphones. Ideal for use with all types of transceivers. $3.50 pair.
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COLLINS TRANSCEIVERS
Auto-tuned 100-150MHz. 10 channels.
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HALF-INCH RECORDING TAPE
Top grade 2400' on 10½" reels. Ideal video experimenting. Only $1.50 per reel.
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Cuts sheet metal like a punch and die, trims, notches and cuts to any size or shape over 7 16-inch.
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1.2 Volt, fully charged, 4in x 3in x 1in 4 AH.
$1 each.
Post N.S.W. 25c. Interstate 35c.
3.6V 10AH, set of three batteries in wooden holder, $7.50 per set or $2.50 per battery 1.2 volt 10AH.
Post N.S.W. $1.10; Interstate $2.72.

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Q5 190-550 K/ CS. **$22.50**
3 TO 6 M/ CS. **$15.00**
6 TO 9 M/ CS. **$15.00**
POST: N.S.W. $1.25, INT. $1.44

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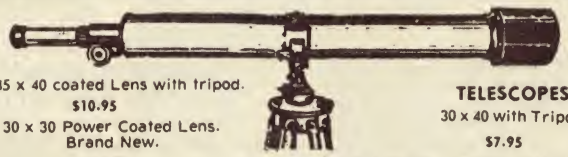

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$10.95
30 x 30 Power Coated Lens. Brand New.
$3.75.
50 magnification with a 60mm coated objective lens. With tripod.
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As illustrated.
Postage $1.20; Interstate $1.45.

TELESCOPES
30 x 40 with Tripod.
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Frequency Meters.
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SMALL COMPUTER PANELS
3in x 2in containing 2 valves, qty. of resistors, etc.
ONLY 75c.
Post 24c.

COMMAND TRANSMITTERS
5-3-7 M/ CS. **$10.00**
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TYPE S POWER SUPPLY
(240 V / AC supply for AT 5-ARB). Suit most types of Disposal transmitters and receivers. Outputs 250 volt, 10mA, 550 volt 200mA, 300 volt 100mA. $30.

BC348 RECEIVER **$80.00**

A.W.A. B.F.O. TYPE R7077
1-800 CYCLES
1-13 K/ CS. **$30.00**

CO-AXIAL SWITCH
70 ohms, 4 positions.
Can be motor driven, completely waterproof, 70 ohms type connectors. Housed in metal case 9in x 8in x 8in, $5 each.
Post N.S.W. 95c.; Interstate $1.45

ELECTRONIC COUNTER
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BRAKE LIGHT . . . from p81

from this number, but this only confirmed that our original figure was correct.

If you have a 12 volt system, with 18 to 20 watt bulbs, this figure will not be very far off the mark for you, too. But just in case, here is how to select the number of turns.

Start by winding 12 turns of wire (16 to 20B&S) directly onto the glass case of the reed switch. Leave a couple of inches at each end, in case you need to add more turns. With a multimeter, check the wires from the brake pedal switch, identify which is the "hot" lead from the battery, and disconnect if.

Connect the hot lead to the junction of the coil and reed switch and the other end of the coil to the vacant brake switch contact. (See circuit diagram.) Connect one side of the indicator light to the reed switch and the other side to the frame of the car.

Now press the brake pedal. Both brake lights should be on. Check to see if the indicator light goes on and stays on. If it does, good. If not, add one or two turns.

Next, remove one of the brake lights from the circuit. In most cars, this involves no more than separating a quick connect terminal, or removing the bulb. Press the brake pedal. The indicator lamp should give a brief flash and then go out. If it does not, add another turn or two until it does. If it comes on and stays on while the pedal is pressed, remove turns, one by one, until it goes out.

We have not described a 6 volt system, as there are not many 6 volt cars on the road these days. But there is no reason at all why the idea will not work with a 6 volt system.

Once the unit is working properly, it can be assembled. We found the that the simplest arrangement was a pair of 3 lug tagstrips mounted on a scrap piece of aluminium. (See photo)

Two leads run from the indicator to intercept the brake line, the most convenient place normally being at the brake light switch, as explained in the coil testing discussion. The leads should be terminated in barrel type connectors to suit those already used in the car.

One other arrangement which comes to mind involves the handbrake warning light with which most modern cars are fitted. With only a little additional effort, this could be made to double as the brake light indicator. There appears to be no objection to this from an operational point of view, and it could be achieved quite simply by connecting the lead from the reed switch direct to the brake lamp, in parallel with the existing connection.

However, one possibility must be considered. If the car is parked with the handbrake on and the brake pedal is pressed, for example by the driver simply using it as a footrest, a circuit will be completed to the ignition coil. At the very least this is undesirable, since it could lead to overheating of the coil. In some other circumstnnces it might even be dangerous.

This objection can be overcome by a simple modification, as shown in the amended circuit. A silicon rectifier diode of at least 1A, 50PIV rating is connected netween the handbrake switch and the lamp.

In this position, it will be reverse biased in the circumstances mentioned, and will not conduct. Under normal running conditions, it will be forward biased with the ignition switch and handbrake on, and the lamp will light. If the footbrake is pressed, the lamp will light because of the direct connection to footbrake indicator.

While this arrangment involves the cost of a diode, it saves the cost of the indicator bezel, and the overall cost should be about the same. It also has the advantage of not requiring that a place be found to mount the indicator bezel, and that the installation will look rather more professional.

Either way, this little device may well save some embarrassment if it warns, in time, that all is not well with your brake lights.

ANSWERS — continued

plans for new designs at present. However, we will keep the idea in mind and note what other requests we receive. In the meantime we can supply reprints of previous projects for the usual 50c fee.

INTERCOM: I am trying to find a simple circuit and instructions for installing an intercom. This is for a boy aged 14, so it will have to be fairly simple. Also, you have previously printed a book "Radio For Beginners". I would like to get a copy. Could you please advise me of the price, etc. (A.S., Georges Hall, N.S.W.)

We published two intercom units last year, A.S. The first in August, and the second, a much simpler one, in October. (File numbers 1/IA/13 & 1/IA/14 respectively). Copies of either of these may be obtained through the information service for the usual 50 cent fee. The book we publish is called "Basic Electronics". It is an up-dated version of the old "Basic Radio Course." The cost is $2.00, plus thirty cents postage.

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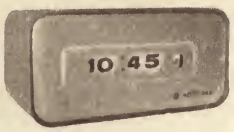

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Index to Advertisers


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With its distinguished heritage and remarkable performance, the new era Wharfedale "Linton" stereo amplifier is attractively styled and complements *perfectly* the new era Wharfedale "Linton" turntable and the new era range of compact Wharfedale speaker systems.

Power output is 15 watts R.M.S. per channel into 8 ohm speaker loads, and frequency response is 30-20,000 Hz. ± 1 dB. at full rated output.

Sensitivity of the new era "Linton" amplifier suits magnetic stereo cartridges at 3.5 mV. and T.H.D. does not exceed 0.1% at 1 kHz. into 8 ohm speaker systems at full output.

Tone controls for bass and treble response offer unusual flexibility . . . piano-key switches are provided for *mode, treble filter, tape monitor, tape input, phono input* and *tuner.*

Quality in design and manufacture is reflected by the performance the new era "Linton" amplifier offers; although completely compatible with other Wharfedale components it is also worthy of selection by the many audio enthusiasts looking for a medium priced stereo amplifier produced by an established company which jealously protects its reputation.

Ask for a no-obligation demonstration at any Simon Gray dealer!

2 THE NEW ERA WHARFEDALE "LINTON" TURNTABLE.

The new era Wharfedale sound source blends beautifully with the other components of the Wharfedale system. Designed to take records of 7", 10" and 12" diameter, the new era "Linton" turntable also features four speeds — 16⅔, 33⅓, 45 and 78 r.p.m.

You may adjust the "Linton" turntable for either *Manual* or *Automatic* operation, *switch-off* and *return* are automatic, stylus tracking pressure is *fully adjustable,* a bias compensator is incorporated and the arm lowering device is hydraulically damped to *protect your records.*

Even at low stylus pressures the low mass, ball bearing construction pickup arm will *track perfectly.*

The magnetic stereo cartridge fitted is the well known Shure M44-7, complete with diamond stylus. This particular unit was selected from a vast range and is *fully compatible* with all other components in the new era Wharfedale stereo system. Output from the cartridge is 2.2 mV.

This reliable and versatile four speed Wharfedale turntable may also be use with your existing high quality stereo amplifier and/or speaker systems.

WHARF

EDALE

3 THE NEW ERA WHARFEDALE "LINTON 2" COMPACT SPEAKER SYSTEM.

Featuring an entirely new 8" bass speaker with an oversize magnet which produces exceptional performance, the new era "Linton 2" is both attractive and compact. Brought right up-to-date in design by one of Britain's leading industrial designers, this hand finished enclosure will match any existing decor; it blends particularly well with the latest Scandinavian furniture where simplicity of line is as important as function.

Frequency response of the new era Wharfedale "Linton 2" is 55-17,000 Hz. ± 3 dB. and power handling capacity is 20 watts DIN. Size is only 19" x 10" x 9½" and finishes available include oiled teak and polished walnut. A new 2" tweeter unit covers all frequencies from 1,200 Hz.

4 THE NEW ERA WHARFEDALE "LINTON 3" COMPACT 3-WAY SPEAKER SYSTEM.

Identical in cabinet design and size to the 2-way "Linton 2", the addition of a 4" mid-range speaker to the speaker complement brings smoother overall frequency response and added "*presence*" to stereophonic playback.

The 8" bass speaker features a newly designed and sizeable magnet assembly for added sensitivity; a long-throw voice coil assures that bass response is *free from restraint* and *particularly faithful*.

Frequency response is 55-17,000 Hz. ± 3 dB., and power handling capacity is 25 watts DIN. Size is 19" x 10" x 9½" and the new era Wharfedale "Linton 3" is also available in oiled teak or polished walnut veneers.

Wharfedale's long experience in the design and manufacture of high quality loudspeakers is evident in both "Linton" models.

5 THE NEW ERA WHARFEDALE MODEL DC9 CASSETTE TAPE RECORDER.

With the Dolby System*!

The release of the new era precision built Wharfedale Model DC9 Cassette Tape Recorder heralds a major breakthrough for cassette recording. The advantages of tape cassettes are well known . . . size, storage, reliability, etc. Only two factors prevented the more extensive use of tape cassettes . . . seemingly limited frequency response and an unfortunate signal-to-noise performance. **Thanks to the Dolby System, both problems have been solved.**

What does the Dolby System do in the new era Wharfedale DC9? It reduces the annoying background tape "*hiss*" introduced in tape recording. When the sound is recorded the Dolby circuit automatically and electronically *amplifies* the low level, high frequency sounds. When the tape is played the Dolby circuit *depresses* these sounds and also considerably reduces the "*hiss*". The original signal is *faithfully reproduced* with *remarkable fidelity*. The surface noise disappears; high frequency "*hiss*" is eliminated.

Precision tape transport mechanism is naturally used in the new era Wharfedale DC9. Frequency response 50-12,000 Hz. ± 2 dB., wow and flutter less than 0.18%, signal-to-noise ratio better than 50 dB. Total harmonic distortion at —3 VU is less than 1.5%. Cross-talk is better than —35 dB. at 1 kHz. Speed variation is ± 1%, fast forward and reverse time less than 120 seconds.

**Now for the first time the high fidelity stereo enthusiast can invest in a tape cassette system . . . Wharfedale, of course . . . with complete confidence.*

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6 NEW ERA STEREO HEADPHONES FROM WHARFEDALE!

For personal listening Wharfedale's new era stereo headset Model DD-1, is quite unbeatable. Each 'phone is virtually a two-way speaker system in its own right. Using the dynamic moving coil principle each wide range unit features a separate bass and treble reproducer with an electrical crossover network.

Impedance is 8-16 ohms and frequency response is 16-22,000 Hz. Distortion is less than 1%, *an extraordinary figure for a stereo headset.*

Concerned about *comfort?* There's no need to worry. Specially tested foamed ear-pads offer fatigue free listening, hour after hour after hour. The cushions are easily removed for cleaning . . . and as 15 ft. of tangle-proof cable is supplied, you may sit some distance away from your amplifier.

When you visit your Simon Gray dealer for a demonstration, ask to hear the new era Wharfedale Model DD-1 headphones. *Don't be shy* — keep on comparing the DD-1 headset with any other 'phones they've got in the showroom at anywhere near the Wharfedale price. *This simple personal demonstration will convince you!*

7 THE COMPACT NEW ERA WHARFEDALE "DENTON 2" AND "DENTON 3"!

Obtaining high fidelity performance from compact speaker systems presents many problems . . . when you listen to the new era Wharfedale Dentons you will realise how well the Wharfedale audio engineers and research "back room boys" have solved the problems inherent in small enclosure design.

Although they measure only 14″ x 9¾″ x 8¾″, both models of the "Denton" sound like *much larger* systems.

The "Denton 2" uses an 8″ long throw voice coil bass reproducer and a 2″ tweeter, with an electrical crossover at 1,400 Hz. Bass and mid-range performance is quite remarkable for an enclosure of these physical dimensions. Frequency response is 60-16,000 Hz. ± 3 dB. and power rating is 20 watts DIN.

As one of the smallest 3-way speaker systems made, the "Denton 3" exploits the full potential of an 8″ bass reproducer, a specially designed 4″ mid-range speaker and the two inch tweeter.

Frequency response is 65-17,000 Hz. ± 3 dB. and power handling capacity is 25 watts DIN. Crossover frequencies are 1,100 Hz. and 4,000 Hz. respectively.

Both models of the new era Wharfedale "Denton" are available in oiled teak or polished walnut veneers — each hand finished enclosure will add grace to existing room settings as they have been designed to match both *period* and *contemporary* furnishing decor.

See the new era "Dentons" at your Simon Gray dealer!

Two new *medium* size, *medium* price, high performance speaker systems from Wharfedale . . . new era "MELTON 2"&"DOVEDALE 3"

8 "MELTON 2"

The Wharfedale "Melton 2" is a 2-way speaker system which sounds as if it costs much more. Measuring only 21″ x 14½″ x 10″ it incorporates a 12″ wide spectrum bass reproducer and a specially designed 2″ C.A.B. tweeter; power handling capacity is 25 watts DIN. Frequency response is 45-17,000 Hz ± 3 dB. Impedance is nominally 6 ohms and finishes available are oiled teak and polished walnut.

Music lovers will appreciate the bass performance of the new era Wharfedale "Melton 2". String tone and woodwinds are also naturally reproduced while trebles are smooth, clean and satisfying.

9 "DOVEDALE 3"!

With the release of the new era "Dovedale 3" Wharfedale have produced the smoothest overall frequency response ever available in a Wharfedale enclosure. With a 12″ bass reproducer, a 5″ mid-range speaker and a 1″ tweeter, frequency response of the "Dovedale 3" Is 45-20,000 Hz ± 3 dB. and power handling capacity is 50 watts DIN. Crossover frequencies are 600 Hz. and 5,000 Hz.

Wharfedale's leadership in loudspeaker technology is evident in the design and manufacture of this fine new speaker system; designed for the dedicated high fidelity enthusiast, the new era "Dovedale 3" satisfies aesthetically and in terms of musical performance. Impedance is nominally 6 ohms and hand finishes include oiled teak and polished walnut.

Size of the "Dovedale 3" is 24″ x 14″ x 12″.

10 THE NEW ERA WHARFEDALE "TRITON 3"!

With three scientifically matched speakers the new era Wharfedale "Triton 3" outclasses most other speaker systems *twice the size* and not a few *twice the price.*

In the new era "Triton 3" an 8″ bass unit is complemented by a 5″ mid-range speaker and an effective 1″ tweeter. The combination offers *restraint-free bass response*, smooth middle frequencies with remarkable *"presence"* and outstanding *high frequency performance.*

Look at the specifications of the new era Wharfedale "Triton 3". See how much more it offers in terms of *musical promise.* When you listen to the "Triton 3" you cannot fail to become more and more aware of the "Triton 3" *fatigue free sound.* This is audio quality you can listen to hour after hour!

Here are abridged specifications: **Size:** 21¾″ x 9¾″ x 9″. **Frequency response:** 55-20,000 Hz. ± 3 dB. **Speakers:** 8″ bass, 5″ mid-range and 1″ tweeter. **Crossover:** 750 and 5,000 Hz. **Impedance:** Nominally 6 ohms. **Power rating:** 25 watts DIN. **Finishes:** Oiled teak or polished walnut.

See your Simon Gray dealer. *Listen critically.* With the new era "Triton 3" you'll be surprised . . . for this is the truly compact speaker system that sets a completely new standard for bookshelf enclosures!

11 THE NEW ERA WHARFEDALE "ROSEDALE".

Bullt to the highest standards *without compromise,* the new era Wharfedale "Rosedale" offers a wide frequency response of 35-20,000 Hz. without coloration and a power handling capacity of 45 watts DIN.

Few speaker systems can handle this power and only a handful do it *well.* The new era Wharfedale "Rosedale" *leads* this select band.

The massive magnet structure on the 15″ woofer helps to give the "Rosedale" its distinctive sound qualities . . . the bass speaker is completely isolated from the 5″ mid-range speaker and the 1″ high pressure tweeter. Crossover frequencies are 700 and 3,000 Hz.

Any tasteful domestic environment will be graced by the clean lines and superb craftsmanship of the new era "Rosedale" which measures 24″ x 23″ x 13½″. Finishes available include oiled teak and polished walnut. This fine speaker system deserves the very best *amplifiers* and equally effective *high quality sound sources.*

If you are looking for a speaker system in the aristocrat range, see your local Simon Gray dealer and listen to the "Rosedale". Make comparisons with any other speaker system in this price category. We invite you to be critical as you listen . . . for we have complete confidence in the new era Wharfedale "Rosedale".
They are not inexpensive. But we believe you will not be prepared to *compromise* . . . for neither did Wharfedale when this superior system was designed and manufactured.

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